Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

DECEMBER, 1953 TECHNOLOGY DEPT.

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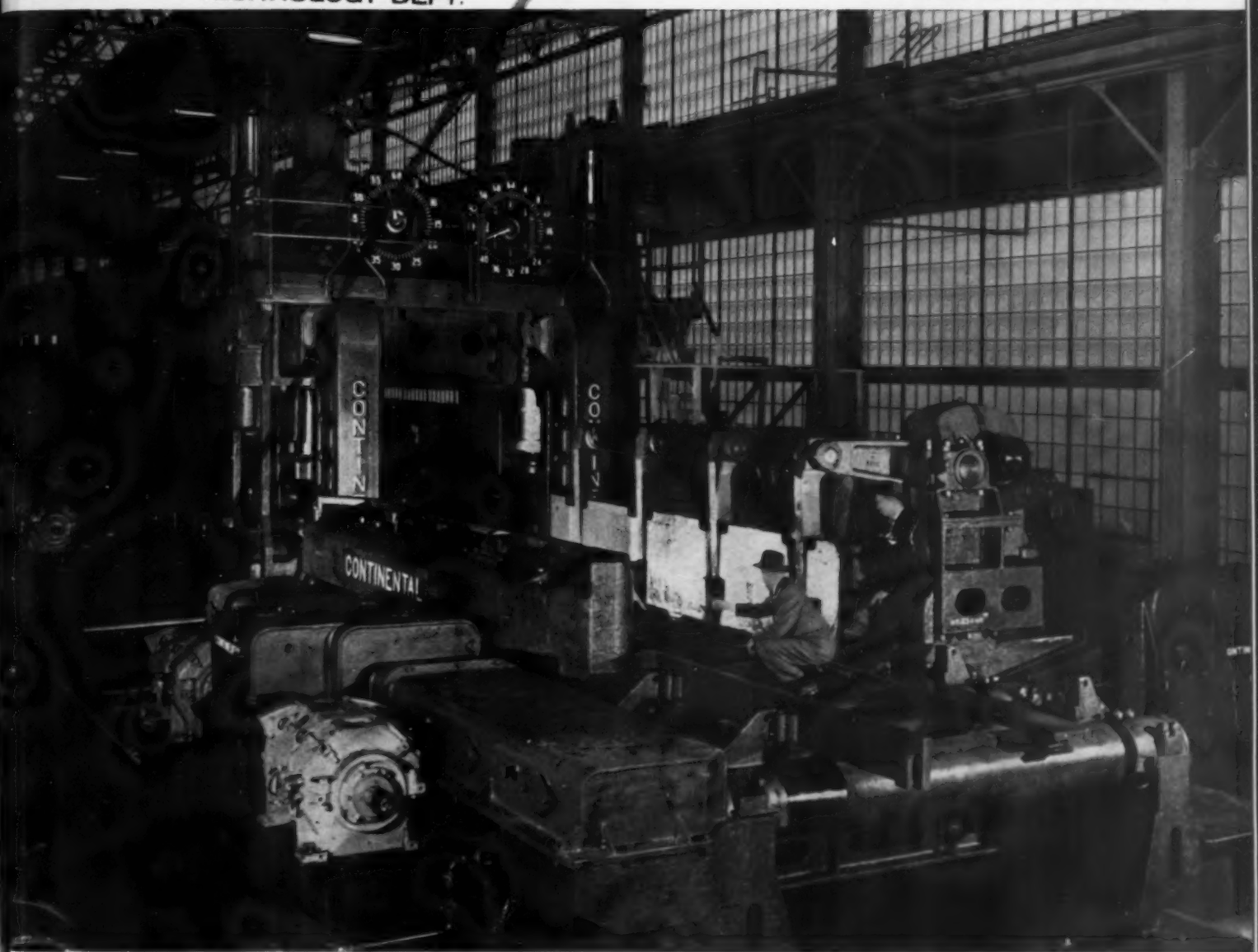


46-INCH HIGH LIFT BLOOMING-SLABBING MILL

Complete Rolling Mill Installations

SLABBING MILLS	Mills complete with Auxiliary Equipment	BLOOMING MILLS
UNIVERSAL MILLS		STRUCTURAL MILLS
PLATE MILLS	★ ★ ★	RAIL MILLS
HOT STRIP MILLS	CONTINENTAL CHIPPER	BILLET MILLS
COLD STRIP MILLS	ROLL LATHES	ROD MILLS
TEMPER MILLS	SPECIAL MACHINERY	MERCHANT MILLS

Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

CHICAGO • PITTSBURGH

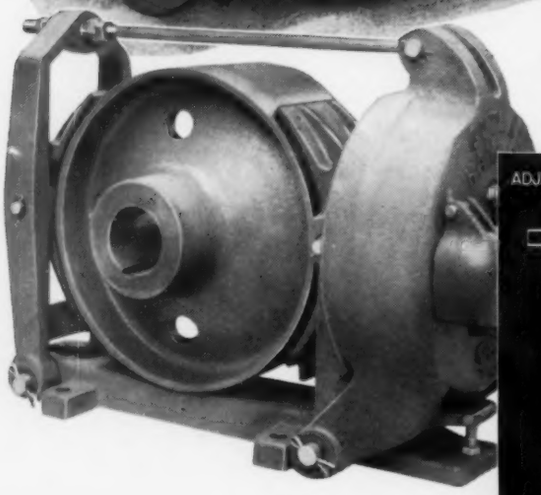
CASTINGS—carbon and alloy steel from 20 to 250,000 pounds

ROLLS—iron, alloy iron and steel rolls for all types of rolling mills

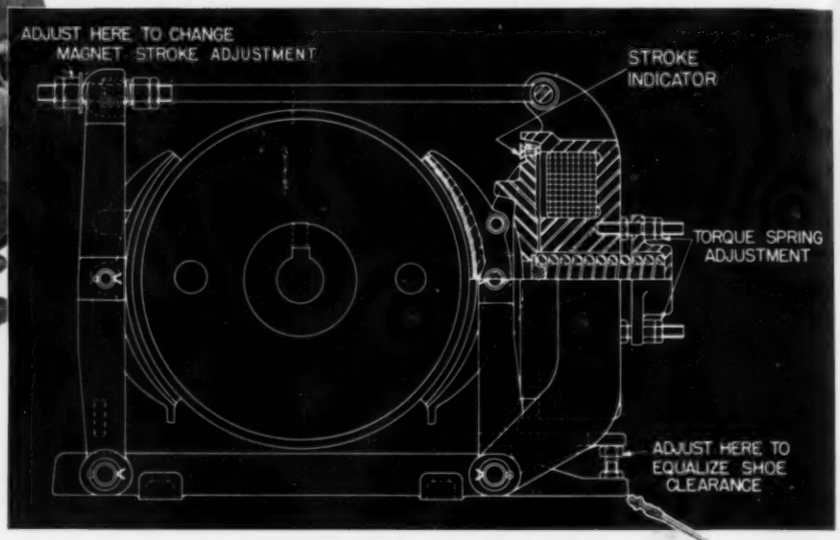
WELDMENTS—fabricated steel plate, or cast-weld design.

CONTINENTAL
Foundry & Machine
Company

Still the Leader!



The design of the Type M Brake is so fundamentally correct its performance has never been equalled


ADJUST HERE TO CHANGE MAGNET STROKE ADJUSTMENT
STROKE INDICATOR
TORQUE SPRING ADJUSTMENT
ADJUST HERE TO EQUALIZE SHOE CLEARANCE

Common sense says there *must* be a best way of doing *any* job. It follows as a consequence any method not equal to the best *cannot* produce equal results. There never has been a mill brake as simple in design or as direct in application of braking power as the Cutler-Hammer Type M Brake. And if the popularity of this brake through the years is a criterion, there never has been a brake to equal it in performance.

The action is a direct push of the shoes against the wheel. Since both the field member and armature move in braking and release, action is lightning fast. The simple design eliminates parts that usually cause trouble and need adjustment and repair. Tough lining matched with durable alloy steel wheel reduces lining wear. Take-up adjustments are needed only at long intervals. Many heavy duty installations prove the Type M Brake to have no equal in performance. Write for Publication BR-2 giving full facts on this brake. CUTLER-HAMMER, Inc., 1255 St. Paul Avenue, Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

14 FACTS about Type M Brake

- √ Fundamental design proved by years of service in heavy duty applications
- √ The simplest of all brakes
- √ Has the fewest parts
- √ The brake with the fastest action
- √ The only brake with one-to-one magnet and total shoe stroke
- √ The brake with only 3 simple adjustments
- √ Longest service without take-up adjustments
- √ Tough long-life lining matched with hard Hammerloy steel wheel
- √ Cover-all tubes shield full length of hinge pins against paint, dirt, etc.
- √ Renewable hardened hinge pin bushings
- √ Hard sheet aluminum magnet coil cover plate caulked in place with aluminum wire
- √ Torque spring compression CANNOT be released manually
- √ Torque spring fully protected
- √ Brass friction plugs keep shoes always aligned

All of these features are also provided, when used on A.C. Service with rectifier

CUTLER·HAMMER
MOTOR CONTROL
C·H

It Set the Pattern Years Ago • It has Set the Pace Ever Since

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada $10.00 foreign countries. Volume 30, No. 12.

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS

flat-rolled finishing equipment

Finishing of sheets, strip, plates and other flat-rolled products, requires many different kinds of machines. Much of this equipment is made by Aetna Standard, such as: High Speed Shearing and Classifying Lines; Levellers, two high and four high; Hydraulic Stretchers; Pay-Off and Tension Reels; Scrubbing and Drying Lines; Slitting and Side Trimming Lines. Illustrated here is a Multiple Block Tension Reel. When you want specialized assistance on your flat-rolled production, call upon Aetna Standard. We have flat-rolled specialists available for you.

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna•Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

ASSOCIATED COMPANIES

Hood Wrightson Machine Company, Ltd., Middlesbrough, England — Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

M. Castello, Inc., New York, N. Y. — Mexico, Central and South America.

Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.

Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.

Hale & Kellogg, Inc., Akron, Ohio — Representative for the Rubber industry.

Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries

Tapping a Heat

A GOOD MIXER

The skilled National Roll metallurgist mixes his batch according to formula, but he also knows through experience the extra ingredients to add to control roll strength, hardness or heat-resistance . . . and when the heat is tapped, it is a certainty that the batch is *right* to produce the roll specified. • Careful attention to a multitude of details in every step in roll making here at National results in sound, long wearing iron and alloy iron rolls that will live up to your service expectations.

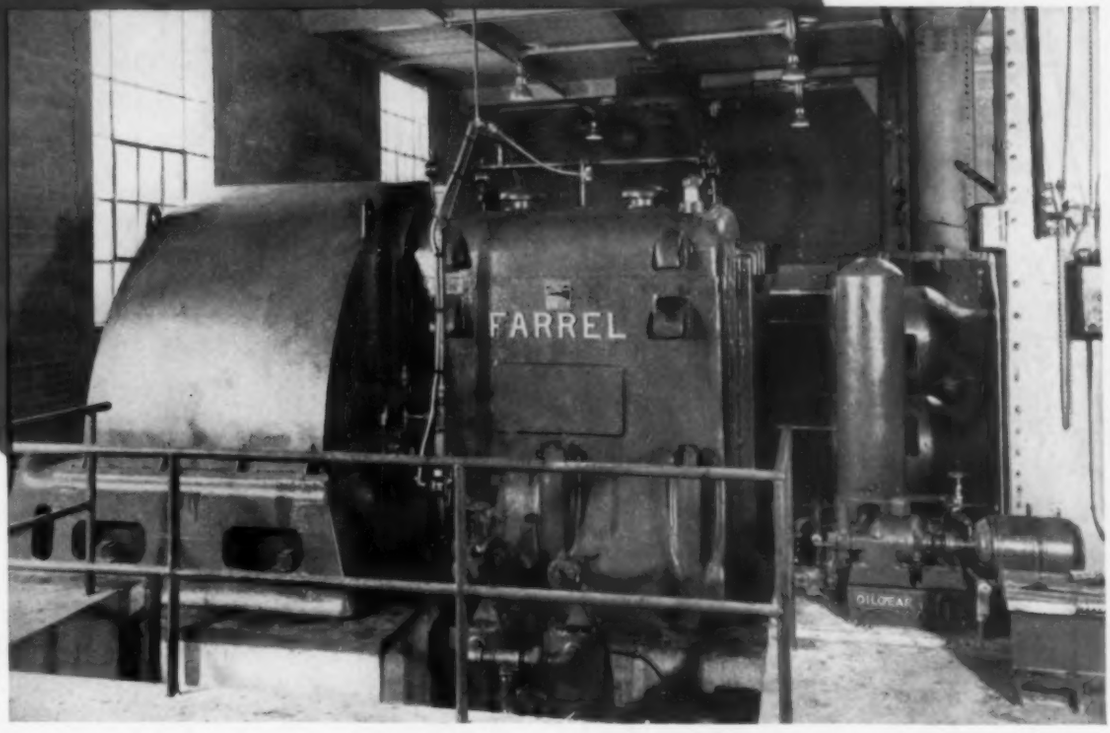
National Rolls

THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

SPECIALISTS IN IRON AND ALLOY IRON ROLLS AND CASTINGS

THE CASE OF THE MISSING GEAR WEAR



IT'S NOT a mysterious case. There's always wear missing when enclosed gears are protected with *Texaco Meropa Lubricant*. In one steel mill (name on request) life of gearing on tin-plate shears was more than tripled.

Texaco Meropa Lubricant has especially sturdy EP characteristics as well as notable resistance to oxidation. It stands up under heavy loads and severe operating conditions; does not thicken or foam. *Texaco Meropa Lubricant* has fine adhesive properties, is not affected by moisture, will not corrode gears or bearings. It does not separate in service or storage.

In roll stand circulating systems, use *Texaco Regal Oil*. It's a heavy duty, turbine-quality oil that separates easily from water, resists oxidation and sludging, keeps systems clean.

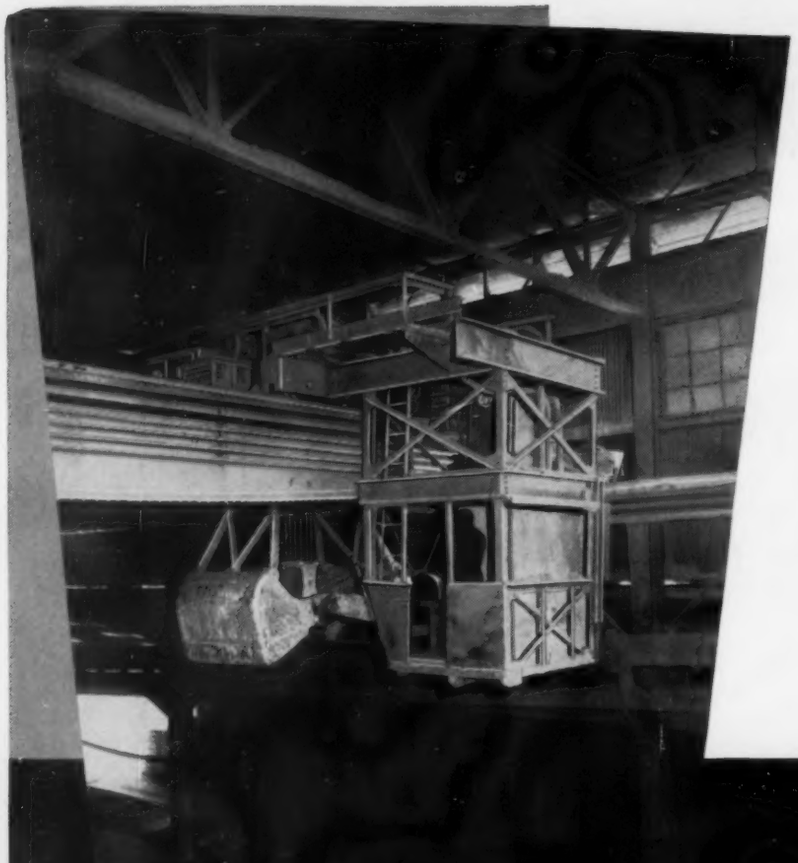
A Texaco Lubrication Engineer will gladly help you simplify and improve lubrication throughout your mill. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

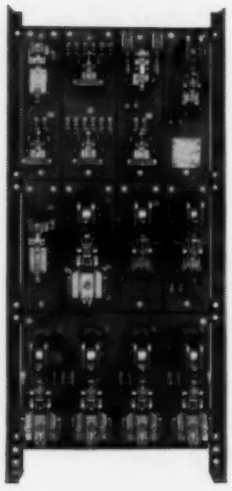
TEXACO Meropa Lubricants

FOR STEEL MILL GEAR DRIVES

TUNE IN . . . METROPOLITAN OPERA radio broadcasts every Saturday afternoon. See newspaper for time and station.



This EC&M Braking Panel replaces all mechanical braking devices in southern fertilizer plant and operates satisfactorily in severe acid atmosphere.



Change-Over to Dynamic Braking Control by EC&M Results in Smoother, Safer Operation of Bucket Cranes

Dynamic Braking Bridge-Stop Control provides an all-electric braking system in which the **driving** motor also acts as the **braking** motor. Operator applies normal stopping by means of a 2-position foot switch which gives two points of dynamic braking depending upon the speed of the crane and the accuracy of stopping desired. Should power fail, dynamic braking is automatically applied to bring the crane to rest quickly, regardless of the position of the master switch.

SOMETHING had to be done! One of the cranes in this plant had partially jumped the runway when power failed at instant of plugging. Ordinary braking methods failed. Magnetically-released, mechanically-set brake wore down rapidly under hard service. Motor burnouts, shaft and gear failures spelled costly delays. Repairs were a nightmare.

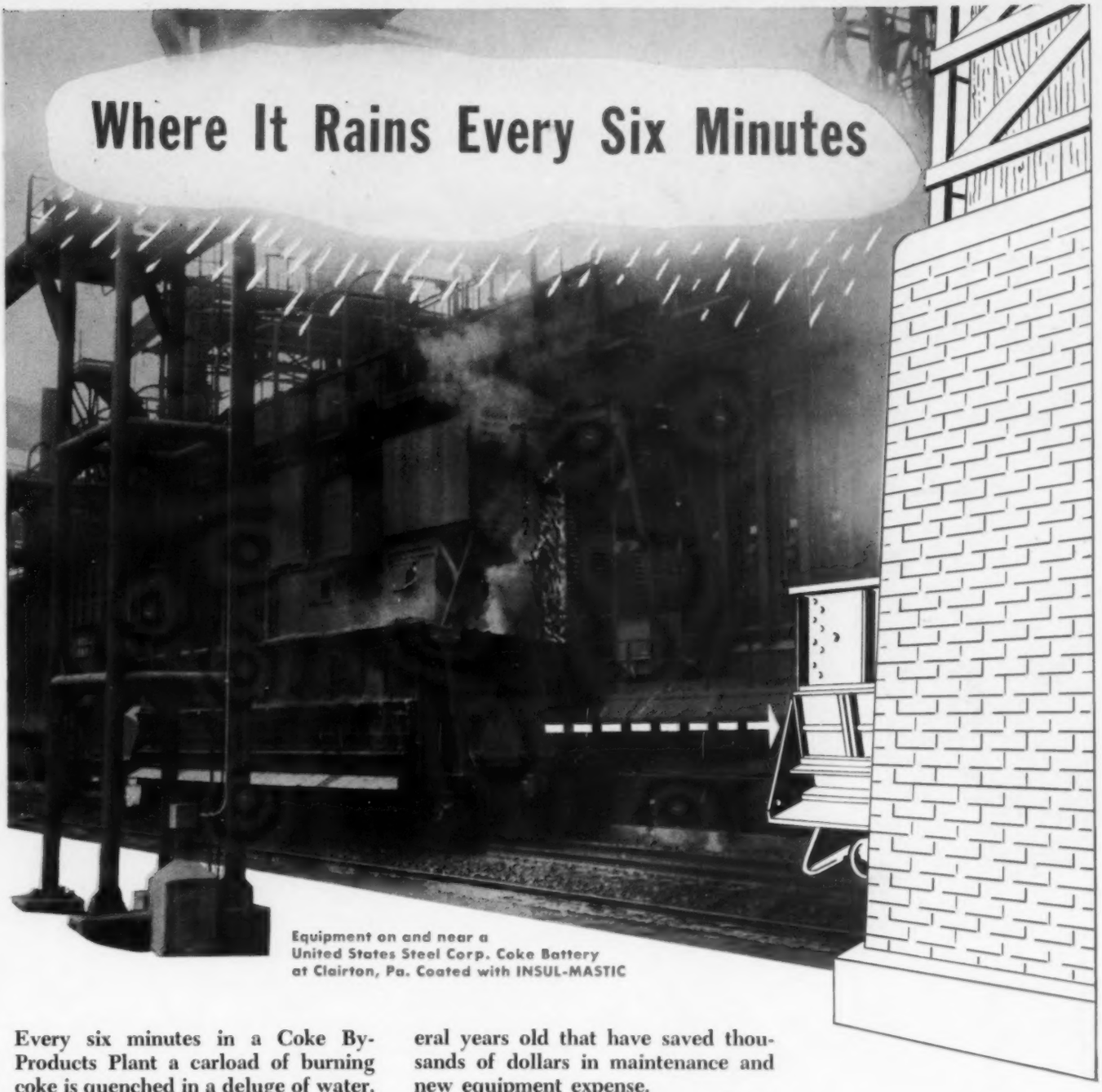
So, a change-over was made to all-electric braking. This eliminated costly production delays. Maintenance became merely a routine inspection of motors and controllers. Operation became 100% satisfactory. And the operators warmed up to the smoother stopping.

Dynamic Braking Bridge-Stop Control offers advantages for your cranes. May we send you Bulletin 921-6.0?

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

Where It Rains Every Six Minutes



Equipment on and near a
United States Steel Corp. Coke Battery
at Clairton, Pa. Coated with INSUL-MASTIC

Every six minutes in a Coke By-Products Plant a carload of burning coke is quenched in a deluge of water. Clouds of steam rise from the car causing a corrosive industrial atmosphere. Corrosion was severe until steel mills and chemical companies began to coat their metal equipment with INSUL-MASTIC. Now, some of these companjes can show you applications several years old that have saved thousands of dollars in maintenance and new equipment expense.

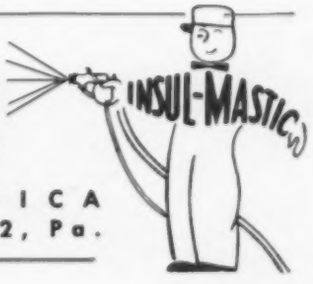
Acids, alkalis, rain and sun will not appreciably shorten the life of the heavy INSUL-MASTIC Bituminous Coatings. Years after they have paid for themselves they will still prevent corrosion. They also Vaporseal Insulation, Waterproof and Insulate.

For a neat looking plant, resurface old masonry buildings with INSUL-MASTIC and Colored Stone Granules.

Write today for the book, "INSUL-MASTIC IN INDUSTRY".

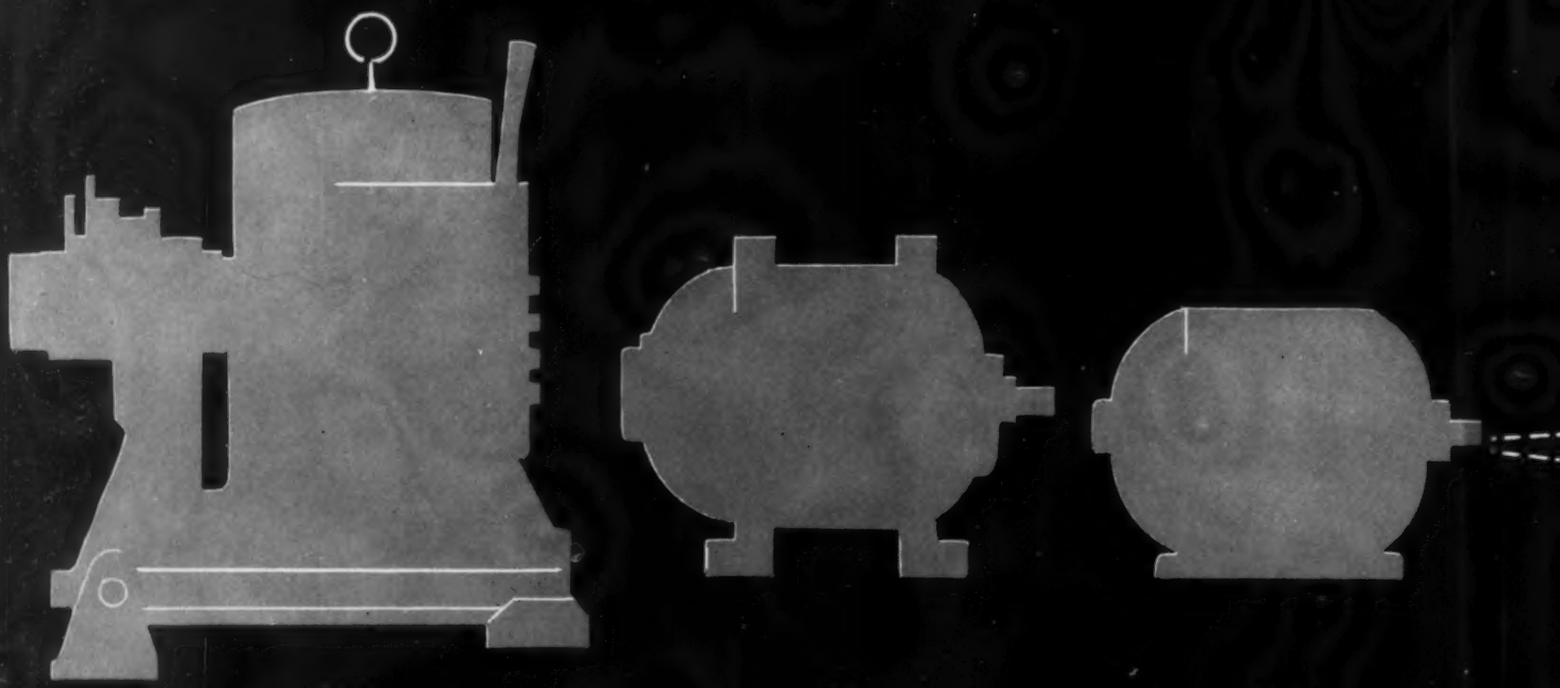
Think First of the Coatings that Last!

Insul-Mastic



CORPORATION OF AMERICA
Oliver Building • Pittsburgh 22, Pa.
Representatives in Principal Cities

WHAT'S NEW IN MOTORS



1888
TESLA
5 H.P.
765 LBS.

1926
CS
5 H.P.
130 LBS.

1947
LIFE-LINE
5 H.P.
119 LBS.

IS STILL TO COME . . .

Hear anything about a new motor? Well, if you think you have, let's set the record straight . . . What's New In Motors Is Still To Come!

Westinghouse has been a leader in the designing and manufacturing of motors for over 60 years. During these many years, over 20 million dollars has been spent on the development of basic lines of induction motors to maintain this leadership. Here are the real years of "new motors" in the parade of progress:

1888—*THE FIRST A-C MOTOR—THE WESTINGHOUSE TESLA MOTOR*

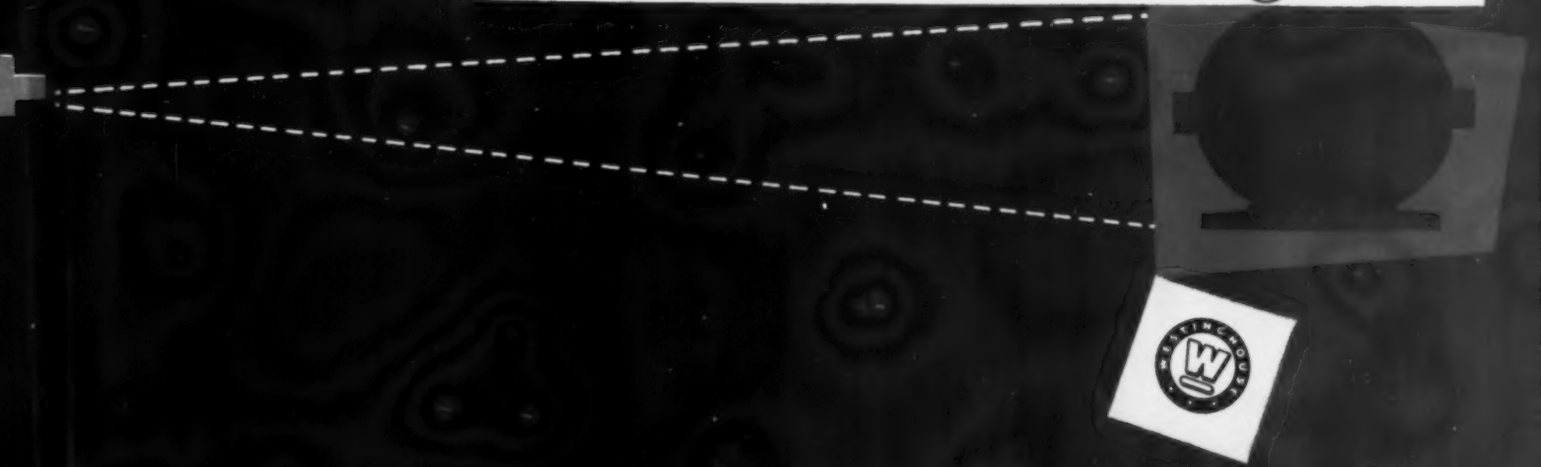
1926—*THE FIRST SEALED SLEEVE BEARINGS—THE WESTINGHOUSE CS MOTOR*

1947—*THE FIRST MOTOR WITH PRE-LUBRICATED BEARINGS PLUS A ⅓ WEIGHT AND SIZE REDUCTION—THE WESTINGHOUSE LIFE-LINE MOTOR*

The smaller, lighter Westinghouse Life-Line Motor of 1947 was the last major contribution. *AND FOR THE NEXT ALL-IMPORTANT STEP AHEAD IN MOTOR PROGRESS . . . LOOK TO WESTINGHOUSE.*

YOU CAN BE SURE.. IF IT'S Westinghouse

J-21834



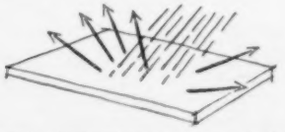
the practical answer to your rust problems indoors and out . . . . . so easy to use that one man often does the work of two.

FACTS

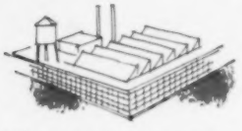
prove the economy of Rust-Oleum

Apply Directly Over Sound Rusted Surfaces—Brush Rust-Oleum 769 Damp-Proof Red Primer *directly* over *sound rusted surface* after scraping and wirebrushing to remove rust scale and loose rust. Sand-blasting, chemical pre-cleaning and other costly preparation methods are *not* usually required.

Available In Many Colors, Aluminum, and White, Brush, Dip, or Spray—Get *double protection.* Beautify as you protect with Rust-Oleum finish coats in the color of your choice.



Practical, Economical Answer To Your Rust Problem—Rust-Oleum resists rain, heat, fumes, sun, salt air, salt spray, and many chemicals—as well as condensation indoors.



Proved Throughout Industry For Over 25 Years—On tanks, girders, pipes, machinery, roofs, buildings, fences, stacks, throughout industry — Rust-Oleum has *proved* its capacity to stop rust for over *25 years.*

RUST-OLEUM®

STOPS RUST!

Rust-Oleum *cuts costly manhours!* Just scrape and wirebrush to remove rust scale and loose rust . . . then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over the sound rusted surface.* Rust-Oleum finish coatings available in many colors, aluminum, and white give you *double protection.* Sandblasting and other costly preparations are *not* usually required. Specify Rust-Oleum . . . prompt delivery from Industrial Distributor stocks in principal cities.

Resists Rain, Snow, Heat, Fumes, Weathering, Salt Water, etc.

RUST-OLEUM CORPORATION
2442 Oakton Street, Evanston, Illinois

FREE SURVEY: Ask a Rust-Oleum specialist to conduct a survey including actual applications, tests, and recommendations. No cost or obligation. See Sweets for nearest Rust-Oleum distributor or write for literature today.

There is Only One Rust-Oleum

Distinctive as your fingerprint, Rust-Oleum is an *exclusive formula* developed by a Master Mariner during more than 20 years battling actual rust conditions at sea. It incorporates a *specially-processed* fish oil vehicle that will *dry,* is odor-free, and is formulated in *many colors.* Be sure you specify genuine Rust-Oleum to assure satisfaction. Accept no substitute.

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- ☐ Have a Qualified Representative Call
- ☐ Free Survey
- ☐ Complete Literature
- ☐ Nearest Source of Supply

PLUG A HOLE AND KEEP IT PLUGGED WITH PERMANENTE 84!

You can *keep* holes plugged, *slash* down-time for hot repairs, *boost* steel furnace production with Permanente 84 ramming and patching mix. Here's why:

Permanente 84 shrinks less than 1%—even at temperatures as high as 3000° F—because the periclase grains are pre-shrunk to maximum density and the patented bond does not form appreciable liquids below 3000° F.

This unsurpassed volume stability of Permanente 84 means fewer repairs are needed between heats. And faster repairs are possible because it's easy to use.

Act now! Start using Permanente 84 for open hearth and electric steel furnace rebuilds as well as for bottom, bank and tap hole maintenance. Let Permanente 84 help increase *your* production—and reduce your material costs through superior performance.

SEND FOR BOOKLET giving all the important advantages of Permanente 84 and the companion material, Permanente 165. Upon request, your Kaiser refractory engineer will promptly offer you research, design and installation service to help you obtain more steel tonnage per year, at lower bottom cost per ton. Call or write principal sales offices: *Chemical Division*, Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California. First National Tower, Akron 8, Ohio.

Kaiser Chemicals

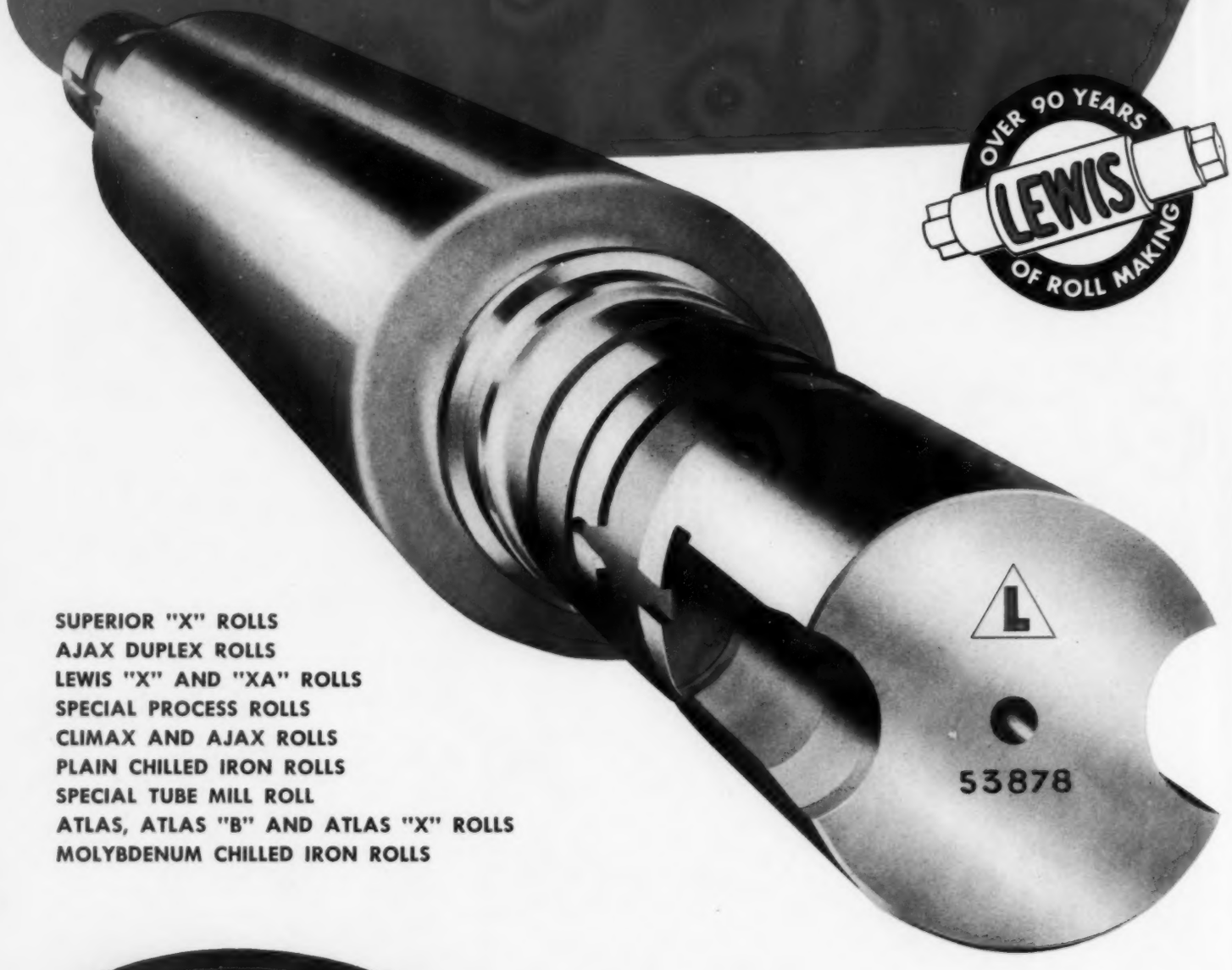
Pioneers in Modern Basic Refractories

Basic Refractory Brick and Ramming Materials • Dolomite • Magnesia • Magnesite • Alumina • Periclase

THE QUALITY OF SERVICE RENDERED BY...

...LEWIS ROLLS is recognized

by all practical rolling mill men



OVER 90 YEARS
LEWIS
OF ROLL MAKING

SUPERIOR "X" ROLLS
AJAX DUPLEX ROLLS
LEWIS "X" AND "XA" ROLLS
SPECIAL PROCESS ROLLS
CLIMAX AND AJAX ROLLS
PLAIN CHILLED IRON ROLLS
SPECIAL TUBE MILL ROLL
ATLAS, ATLAS "B" AND ATLAS "X" ROLLS
MOLYBDENUM CHILLED IRON ROLLS

MANUFACTURERS OF
ROLLS FOR THE IRON, STEEL AND
NON-FERROUS INDUSTRIES

may we have the opportunity of studying your requirements and submitting our recommendations

ROLLS DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH, PA.

CODDLE THE COMMUTATOR

WITH NATIONAL BRUSHES FOR MAIN-DRIVE, MILL-TYPE and GENERAL-PURPOSE MOTORS

TRADE-MARK

PROPERLY MAINTAINED, commutators are among the least of your operating worries. Neglected, they can cause reduced efficiency, shortened brush life, costly down-time — even, in extreme cases, shutdown of production.

AT THE COMMUTATOR, more than at any other motor component, *minutes,* regularly spent on care, add *hours* to the period between overhauls. Coddle the commutator, and your motors and generators will return your investment many times over.

AN IMPORTANT PART of commutator care is the proper selection of brushes, brushes that give peak commutation . . . low friction . . . proper surface film — "NATIONAL" BRUSHES!

SATISFY THESE CONDITIONS and your brushes will *last* longer, too — as "National" brushes are known to do!

How good is really good brush performance?
— Try "National" brushes and see!

The term "National", the Three Pyramids device, and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

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A Division of Union Carbide and Carbon Corporation
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NATIONAL STANDARDIZED BRUSHES
BETTER— PRODUCT—PACKAGE—PRICE— FASTER

Big Producers

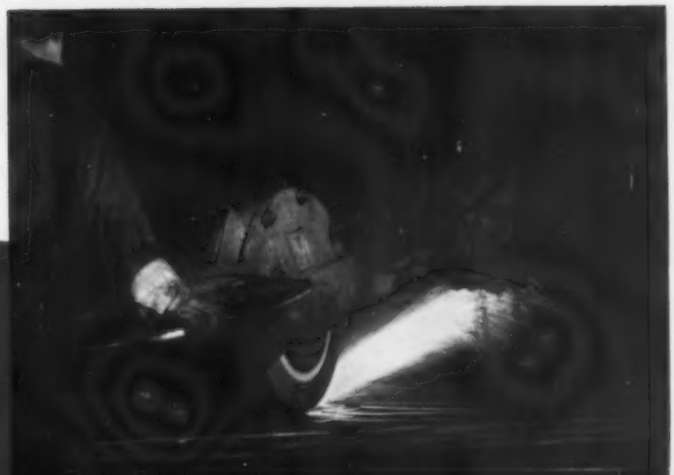
for

STEEL MILL GRINDING

Condition your billets the fast, dependable way! For top tonnage ground per wheel dollar, use Simonds wheels. Made in coarse, hard grades for fastest stock removal on alloy steel billets and slabs. Write for snagging bulletin ESA 62.

for YOU..

for high and low speed SNAGGING



SWING FRAME GRINDING

FLOOR STAND GRINDING

RESINOID BONDED WHEELS: For fastest grinding — used on high speed grinders up to 9,500 surface feet per minute. Patented Red Streak Flanges available on wheels with 6", 10" and 12" hole sizes.

VITRIFIED BONDED WHEELS: For your regular or low speed grinders not exceeding 6,500 surface feet per minute. Made in newest type continuous tunnel kilns for greatest uniformity of grinding action.

Typical shipment of Simonds Snagging Wheels to a large user

SIMONDS ABRASIVE COMPANY • TACONY & FRALEY STS. • PHILADELPHIA 37, PA.

BRANCH WAREHOUSES: CHICAGO, DETROIT, BOSTON

Division of Simonds Saw and Steel Co., Fitchburg, Mass. Other Simonds Companies: Simonds Steel Mills, Lockport, N. Y., Simonds Canada Saw Co., Ltd., Montreal, Que. and Simonds Canada Abrasive Co., Ltd., Arvida, Que.

...with TYCOL lubricants on hand!

The "All-Weather" Bearing Lubricant! Steel mills have shown a lively interest in Tycol Acylkup 4, a year 'round bearing grease that does a variety of jobs with a complete disregard for thermometer readings. Although all methods of application are suitable, one "3-Furnace" mill has found it particularly adaptable for use in its automatic grease systems – with complete ease of pumping even in the coldest weather. From Blast furnaces: Sheave Bearings, Bell Mechanism, Skip Hoists, etc. . . . to Coal and Ore Bridges, Tycol Acylkup 4 is a natural for lubricating yard equipment in every steel mill. With two big savings: "all weather" protection . . . and lowered maintenance costs on automatic pressure systems. For details, contact your local Tide Water Associated office!

TYCOL
INDUSTRIAL LUBRICANTS

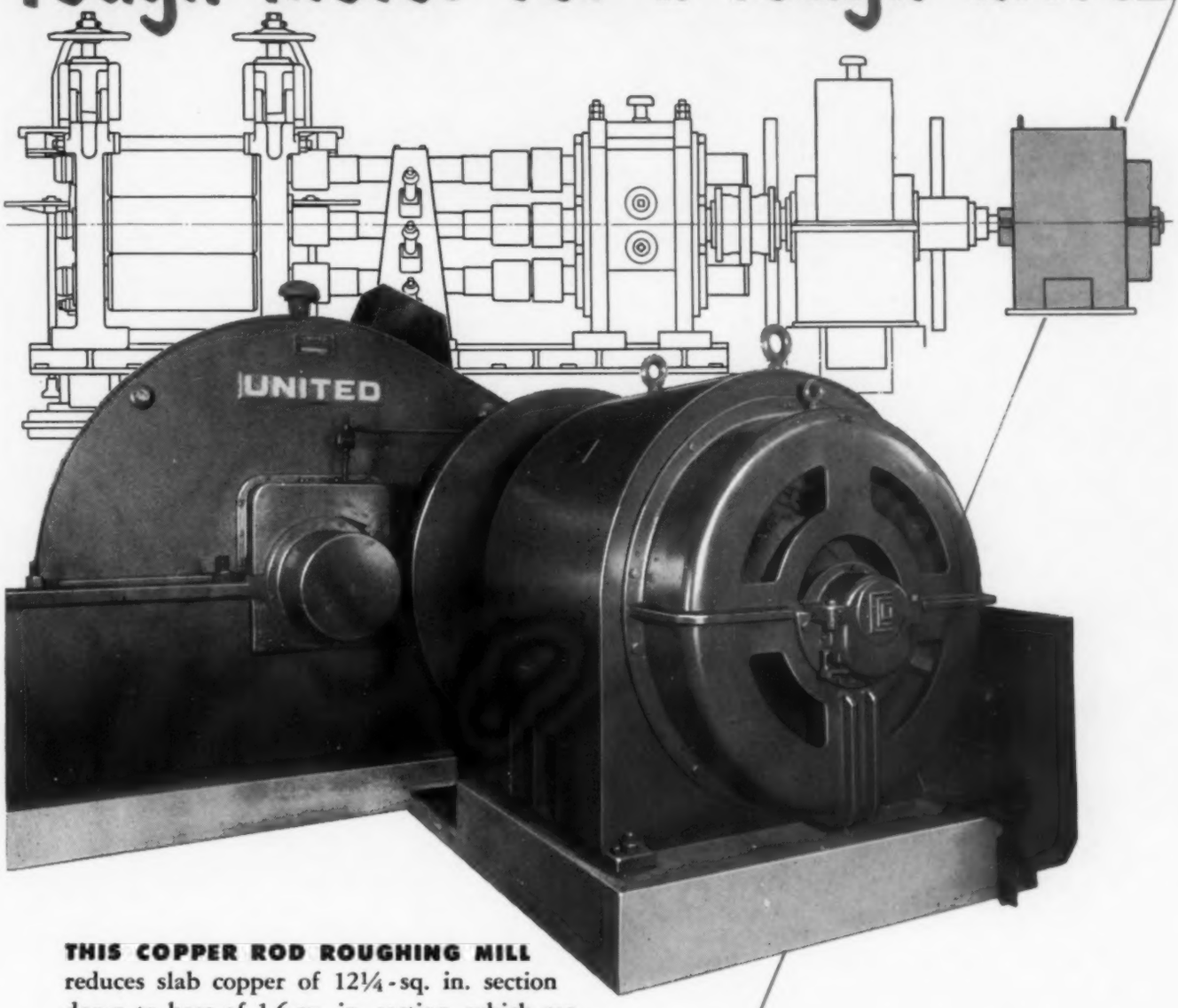
Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco
Toronto, Canada

Over 300 Tycol industrial lubricants are at your disposal . . . engineered to fit the job!

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

REFINERS AND MARKETERS OF VEEDOL . . . THE WORLD'S MOST FAMOUS MOTOR OIL

Tough motor for a tough drive



THIS COPPER ROD ROUGHING MILL reduces slab copper of 12¼-sq. in. section down to bars of 1.6-sq. in. section, which certainly ranks as rugged service, demanding a motor that can take shock and heavy current surges. The American Brass Company selected an Elliott motor to drive this new mill, built by the United Engineering & Foundry Company.

The motor is an 800-hp, 710-rpm Fabri-Steel wound-rotor induction motor, with a 300% pull-out torque, driving through gears with a ratio of 6.85:1. Elliott fabricated steel construction provides the rigidity and sturdiness required for this extremely arduous service.

ELLIOTT MOTORS

are widely recognized for their performance in heavy mill drive service. For full details on these motors in their various types, contact your local Elliott engineer, or write Elliott Company, Ridgway, Pa.

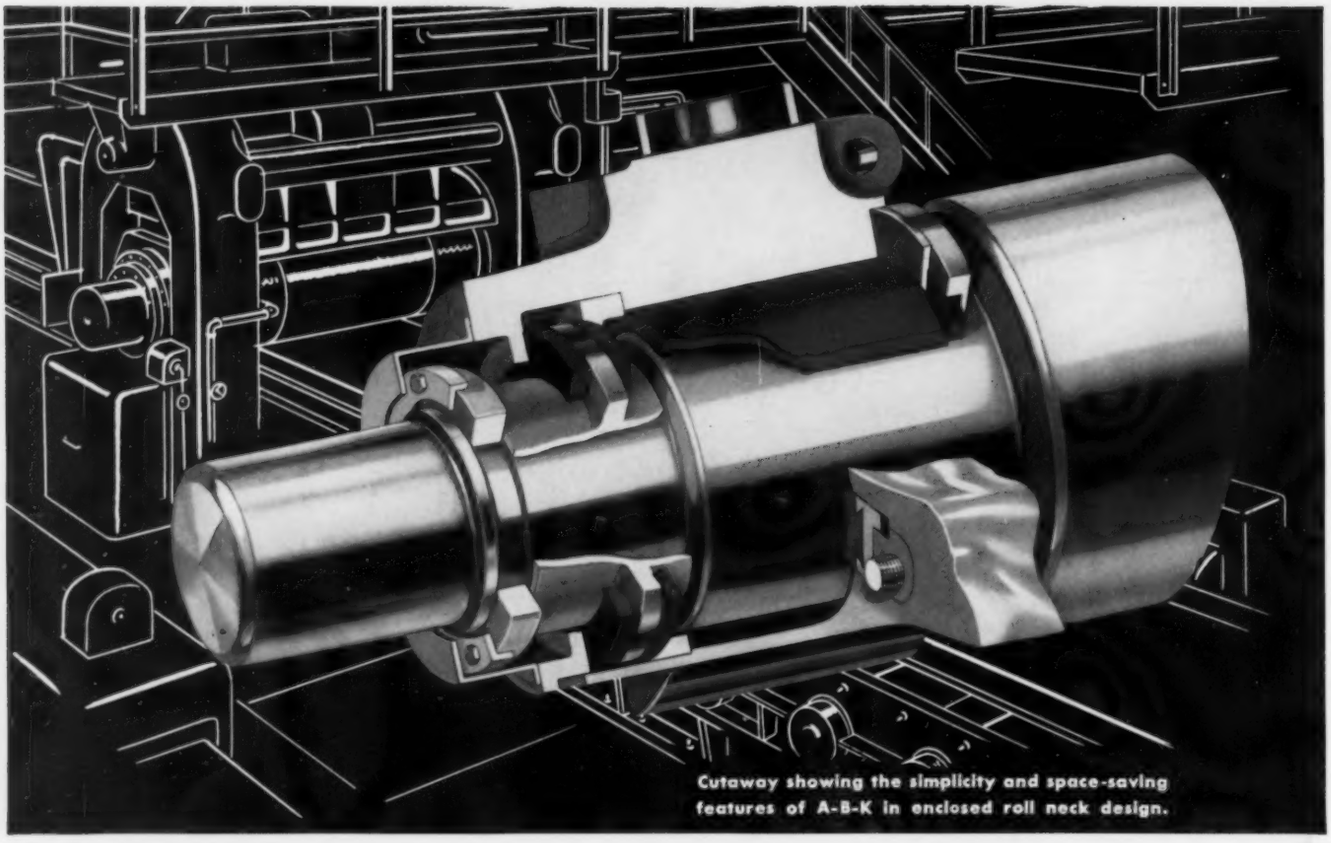
Elliott FABRI-STEEL

ELLIOTT Company

RIDGWAY DIVISION

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.

R3-19



Cutaway showing the simplicity and space-saving features of A-B-K in enclosed roll neck design.

Operating Advantages of Enclosed Neck Design using A-B-K LAMINATED FABRIC BEARINGS

1. **MORE COMPACT BEARING ASSEMBLIES,** hence smaller castings and housings on original equipment.
2. **SIMPLE BEARING DESIGN,** needing fewer, less expensive parts and no special assembly equipment.
3. **LARGER NECK-TO-ROLL RATIOS,** thereby reducing possibility of roll breakage.
4. **IMPACT LOADS CUSHIONED** because of greater resiliency of nonmetallic bearings.
5. **LESS COST TO INSTALL and MAINTAIN,** are light in weight, need no special handling or protection in storage.
6. **WATER LUBRICATION** minimizes grease and oil usage.
7. **ROLL MAINTENANCE COSTS CUT,** won't score or heat check, protect roll necks.

A-B-K®
LAMINATED FABRIC BEARINGS

Copyright 1953, American Brake Shoe Company

AMERICAN Brake Shoe COMPANY

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN
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UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

12-ton ore bridge, built, designed and installed for a large steel company.

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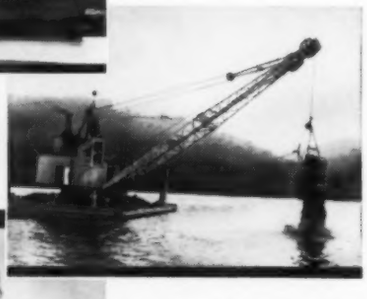
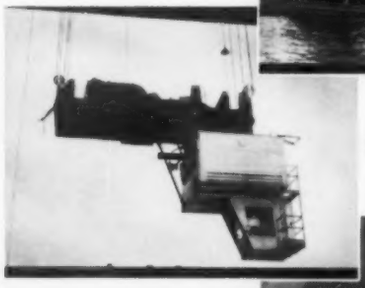
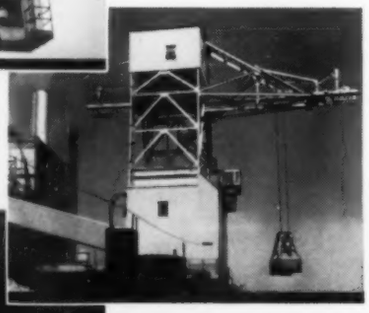
Travelling unloading towers built to handle imported iron ore at an Atlantic port.



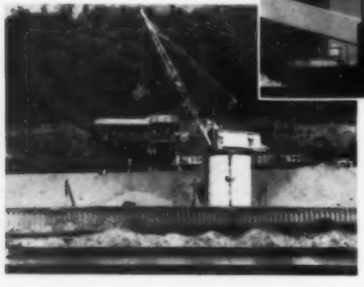
Whirler crane mounted on pontoon hull is used for dredging and general contract work.



Light-weight man trolley installation increased bridge handling capacity 60%.



Coal unloader designed and built for a large mid-western electric power company.



Stationary whirler crane designed and built to transfer coal from barges to hopper cars.

Over-all economical and safe performance is best obtained by using materials-handling equipment designed to suit your operating conditions. If you're planning a new materials-handling installation, we suggest an early "Round Table" session with Dravo engineers.

From actual experience over the past 60 years in building and installing the equipment shown here, valuable data is available in working out the features you want in your installation. This information, along with your own operating experience, can be used to create a design incorporating all the best features for easy maintenance, a high safety factor and simple, economical and satisfactory operation.

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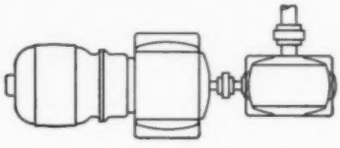
How to change even complex speed reduction problems into *simple* ones

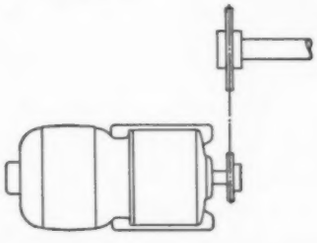
WORM GEAR DRIVE

WORM GEAR and P.I.V. variable speed drives are shown direct-coupled. Link-Belt worm gear drives are available in 3.1:1 to 8000:1 reduction ratios—1400 to 123,000 in. lbs. torque—0.22 to 564 output shaft rpm. Ask for Book 2324A.



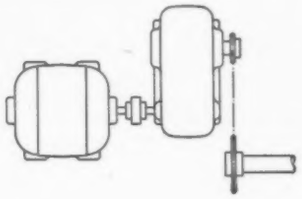
GEARMOTOR & HELICAL GEAR DRIVE

GEARMOTOR is shown with roller chain drive. Link-Belt Helical Gear Drives, Gearmotors and Motogears are available in 6.2:1 to 292:1 reduction ratios—1 to 30 hp—6 to 280 output shaft rpm. Ask for Books 2247 and 2451.



HERRINGBONE GEAR DRIVE

HERRINGBONE GEAR DRIVE is shown connected by flexible coupling to motor and with roller chain take-off. Link-Belt Herringbone Gear Drives are available in 2.84:1 to 326:1 ratios—0.4 to 2480 hp—2.2 to 623 output shaft rpm. Ask for Book 2519.



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For Link-Belt builds a complete power transmission line. There's no need to exchange drawings with a third person to calculate chain, sprocket, coupling, bearing or even shafting requirements. You can get all these from one source . . . each pre-engineered for perfect fit.

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13,128

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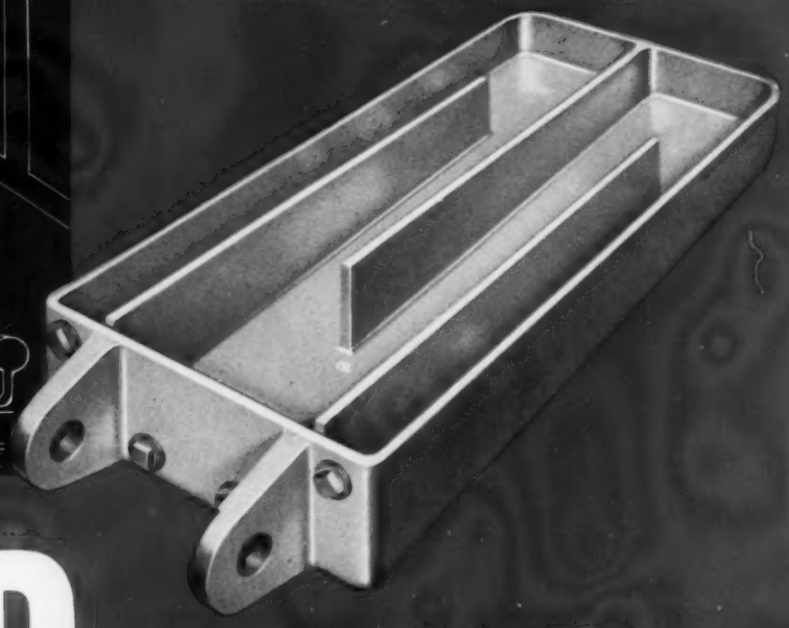

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Patent Reviews

By MELVIN NORD
Patent Attorney
Detroit, Mich.

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . patents reviewed cover period August 11, 1953 through September 8, 1953 . . .

PROFILE METHOD OF MAKING STEEL

▲ A control method for the continuous bessemer process is described by James Fernando Jordan in U.S. 2,649,366, issued Aug. 18, 1953. The method is shown in Figure 1.

Trough 17 is formed by refractory body 16. Incoming raw metal 18 flows into the trough to form flowing metal stream 14, and stream 14 is refined as it flows along the trough by means of a series of impinging air jets which enter the trough through ports 11.

The composition of the metal product is controlled by controlling the location of the flame profile appearing above the datum line 10 which is the top of the trough and the visible base of the flame profile. The flame profile appearing above any given position along the decarburizing phase of the process bears a simple and direct relationship to the progress of the reactions taking place therein and thereunder. The flame profile is therefore spread out sufficiently to resolve it into discernible features which picture the progress of the process.

Incoming raw iron 18 immediately comes under the oxidizing influence of the impinging air jets and slag stream 12. At the outset, a short intense flame appears above the datum line—the beginning of this short flame being represented as A. As the stream flows along the trough, the silicon and manganese are oxidized, together with a certain amount of carbon—the progress of these reactions being represented by a flame profile that may assume the general shape shown between A and B. As the flow proceeds and the temperature of the stream mounts, the height of the flame profile gradually mounts also—due mainly to an intensification of the decarburization reaction. The progress of this intensification is shown by the flame profile and may take the general form shown between B and C,—C representing the decarburizing reaction at the height of its intensity. As C is passed, the profile of flame falls into a rapid decline or break, represented between C and E. D represents an arrest that sometimes occurs in break C-E, particularly in acid practice, being presumably the result of the sudden oxidation of some compound or element that yields a flame of high luminosity. The flame profile continues to decline until E is reached, representing the end point insofar as the oxidation of carbon is concerned.

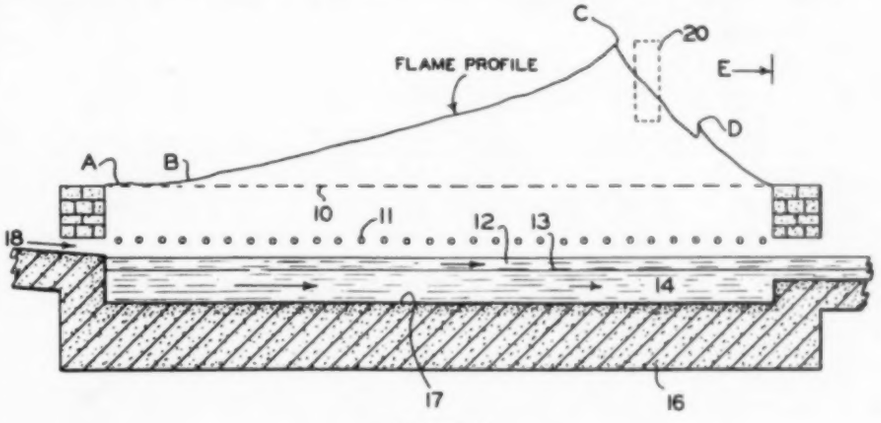


Figure 1

The flame profile may be spread out by increasing the distance between ports or in other ways described in the patent. Standardization of the flame profile for a particular apparatus is obtained by increasing the air input until the desired product is obtained from the apparatus (say 0.05 per cent carbon). A

particular feature of the flame profile is selected for control purposes (between C and E), such as the arrest D or the height of the flame profile. The position of the selected feature along the stream within the trough is noted. The continued production of the desired product is then assured, according to the inventor, if the selected feature of the flame profile is kept at its noted location.

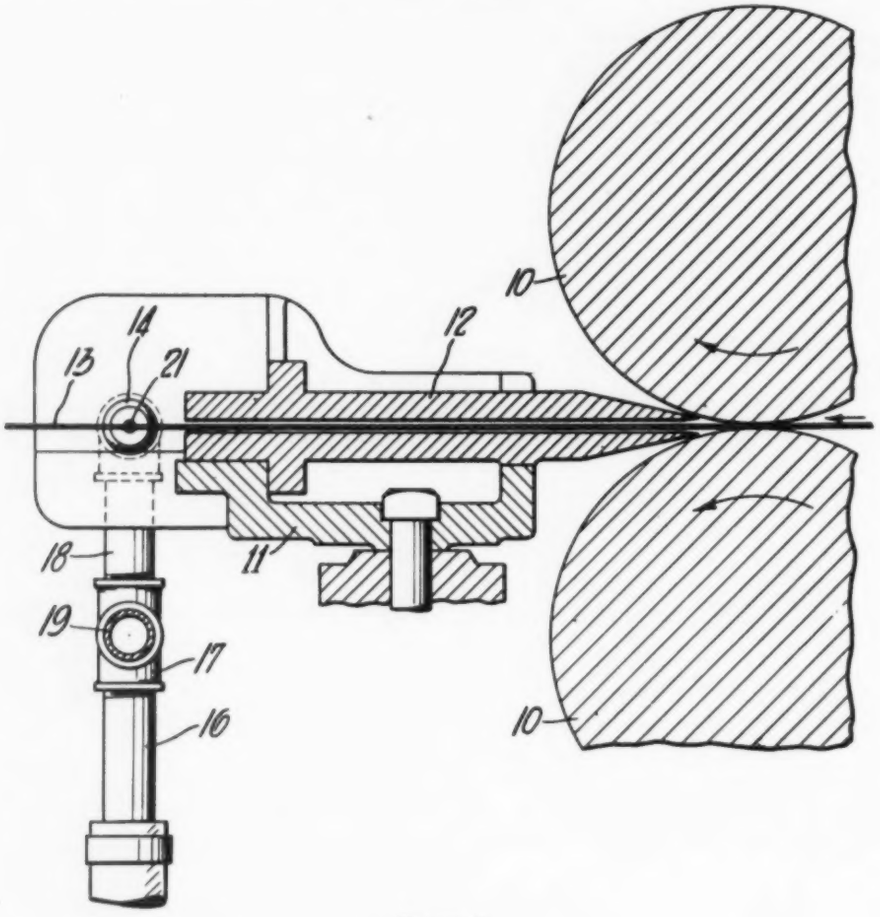


Figure 2

DUST PREVENTION IN HOT STRIP MILLS

▲ When hot steel strips pass through rolls, as for example on finishing stands, there is a tendency for fine scale particles to break off as dust. This can be prevented by means disclosed by Kazmar J. Bores in U.S. 2,648,241, issued Aug. 11, 1953. The apparatus is shown in Figures 2 and 3.

Figure 2 shows a portion of a strip mill, including a conventional pair of rolls 10, 10, a guide box 11 and a guide 12. Hot steel strip 13 being rolled passes through the rolls from right to left as viewed in this figure. Scale on the strip tends to break off and form dust clouds, which arise from the strip beyond the guides.

As shown in Figure 3, a water spray system is arranged to wet the strip as it emerges from the guides. The spray system includes a pair of nozzles 14 and 15, supported at opposite sides of the strip on the guide boxes, as well as suitable water piping. The nozzles are of a design that produces a swirling cone of water that has no appreciable central void space. They are placed so that they discharge water on the edges of the strip directly opposite each other and as close to said edges as practicable. The strip approximately bisects each cone.

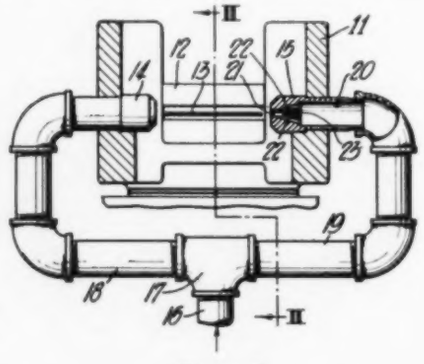


Figure 3

PRODUCTION OF IRON IN A BLAST FURNACE

▲ Part of the lump fuel in the blast furnace can be replaced by finely divided solid fuel, according to U.S. 2,650,161, issued Aug. 25, 1953 to Friedrich Totzek and assigned to Koppers Co., Inc. The finely divided fuel serves only to supply heat, and does not serve as a reducing agent or as a carburizing agent. Molten pig iron is produced.

A mixture of oxygen and finely divided solid fuel is introduced into the tuyeres of a blast furnace. Conditions are so regulated that substantially only carbon monoxide is formed by the reaction, which starts at the outlet of the tuyeres and is completed before the reaction mixture comes into contact with the charge on the hearth. The blast is not preheated, since oxygen is used instead of air, and the whole supply of blast furnaces gas produced is thus available for the synthesis of hydrocarbons or other purposes.

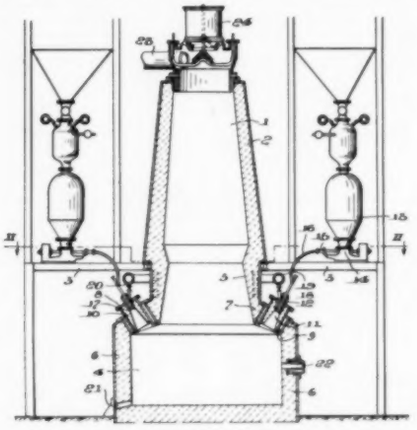


Figure 4

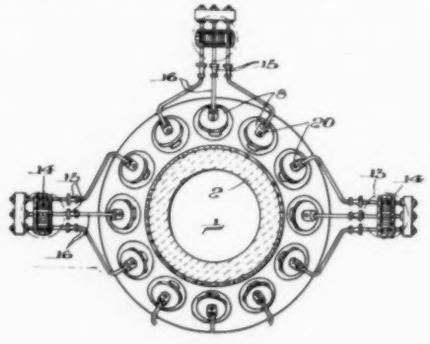
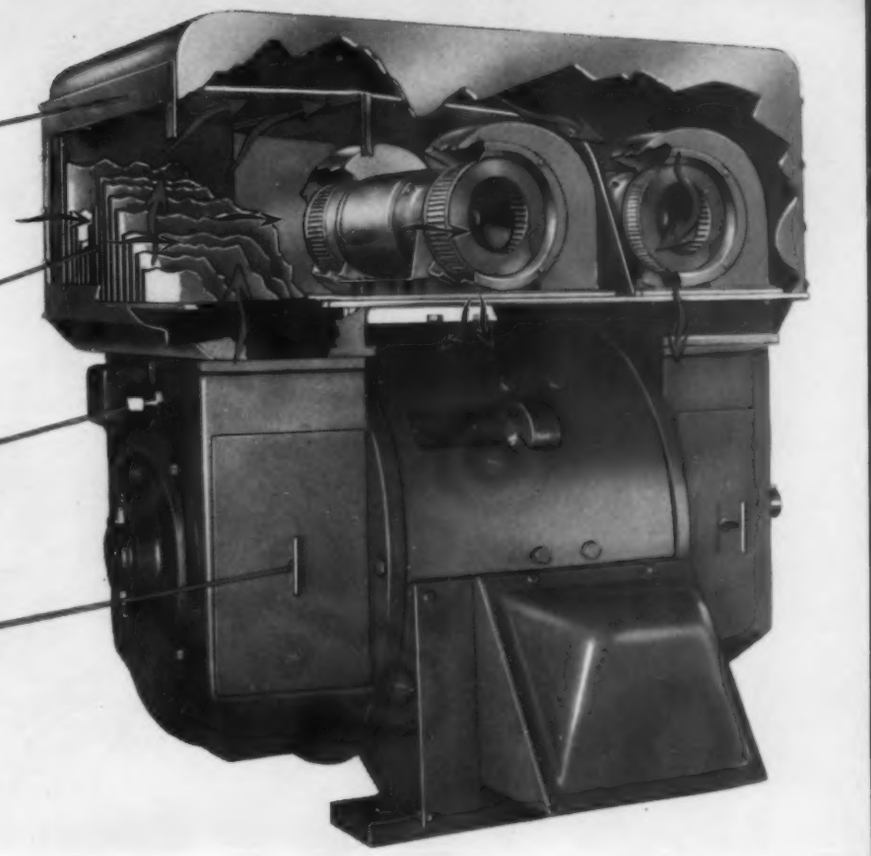


Figure 5



COMPACT, top-mounted cooling unit falls within the over-all length and width of main motor.

SMOOTH vertical plates are self-cleaning. Cooling unit is easy to remove for inspection.

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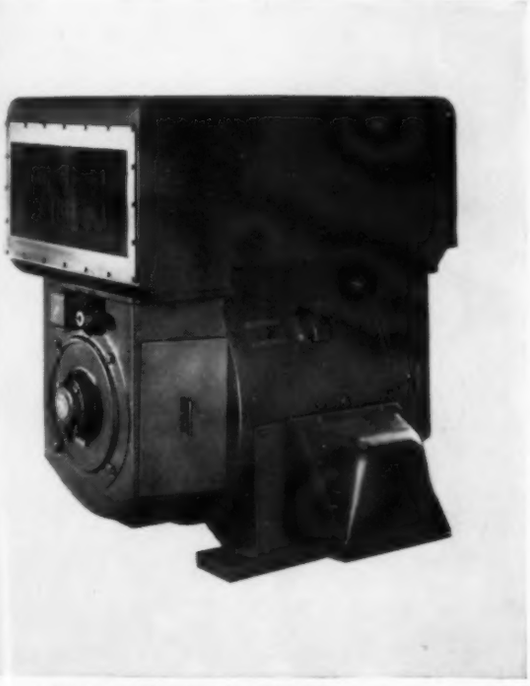

THE SMOOTH STYLING of the new unit-cooled motor is in harmony with good machine design. Smooth contours facilitate cleaning. No ducts or piping are needed on this compact, ready-to-install unit.

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For additional information on ratings and dimensions, contact your nearest General Electric office or write for Bulletin GEA-6091, "Unit-cooled D-C Motors." Address Section 770-31, General Electric Company, Schenectady 5, N. Y.

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Figures 4 and 5 show the blast furnace as used in this invention. A continuous row of gasifier heads 8 is arranged in the arch-like wall 7 between stack and hearth. The gasifier heads consist of a water-cooled jacketed body 9 provided with a refractory lining 10. The lining forms a conical reaction space 11 which opens with its enlarged end into the hearth 4. At the narrower end of the reaction space 11, there is a water-cooled tuyere 12 adapted to introduce the mixture of finely-divided solid fuel and oxygen. The fuel is fed from the storage bin 13 by a screw 14 into a mixer 15, into which oxygen is introduced through a pipe (not shown). An individual mixer is provided for each gasifier head.

TILTING ELECTRICAL MELTING FURNACE OF EGG-SHAPED CROSS-SECTION

▲ In U.S. 2,650,255, issued Aug. 25, 1953 to Lennart K. G. Hogel and Ludwig Dreyfus, and assigned to Allmanna Svenska Elektriska Aktiebolaget, a method of constructing extremely large high frequency electric furnaces is disclosed.

The new furnace is shown in Figures 6 and 7, the former being a vertical section and the latter a top plan of the furnace. In these figures, 1 designates the stamped melting pot, the lower end of which rests on supports 2 and 3 of brickwork. The melting pot is surrounded by a coil 4 of water-cooled copper pipe, and outside this coil, a number of vertically laminated sheet staples 5 are provided, the lower

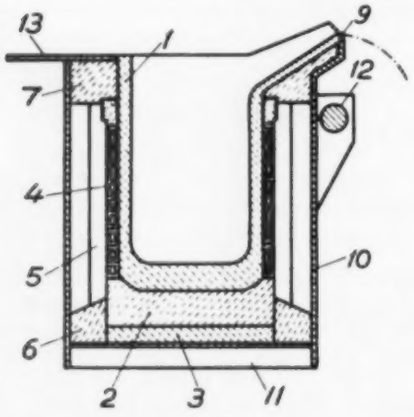


Figure 6

ends of which engage a ring 6 of brickwork. At the upper end, the melting pot is surrounded by a flange 7 of brickwork, and between this flange and the upper end of the pipe coil there is mounted a ring of heat-insulating material. The melting pot is provided with a tapping mouth 9 and the furnace is surrounded by a sheet-metal housing 10 secured at its lower portion to a framework 11, which supports the brick layers 2 and 6. The furnace as a whole is pivoted on a shaft 12. The top of the furnace is covered by a cover plate 13 extending to the melting pot itself.

The melting chamber has parallel vertical walls with an egg-shaped cross-section taken horizontally of the furnace when in its untilted position. The side walls are formed by arcs of circles of relatively long radius, r_1, r_2. The front wall adjacent the spout 9 is described by an arc of shorter radius, r_3, while the back wall is in the form of an arc of still shorter radius, r_4.

It is claimed that this type of construction permits the volume of the melting pot to be more than double the normal size, without exceeding

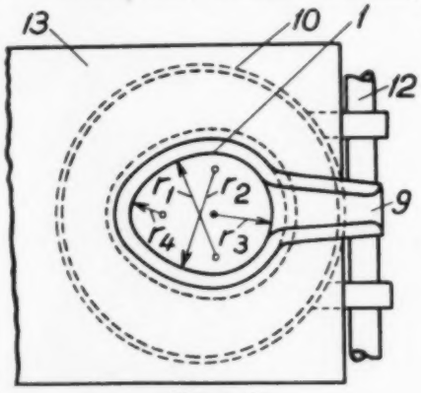
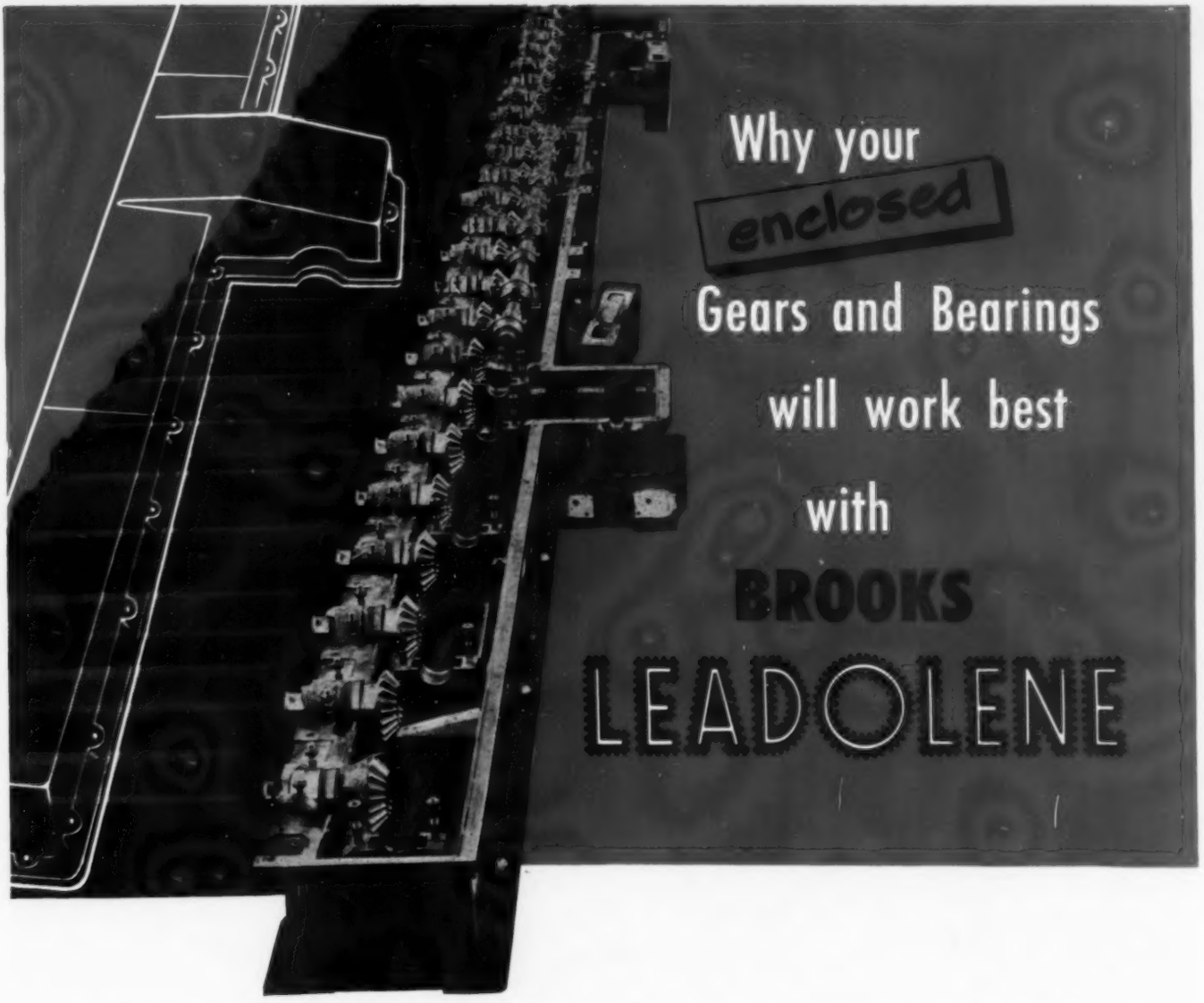


Figure 7

the advisable depth of the bath and without any disadvantages from the points of view of working practice and metallurgy.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,648,278	8/11/53	Apparatus for selectively marking moving strip	Karl O. Neander and Alfred Teplitz
2,648,383	8/11/53	Bloom shear	Johann Hahn
2,648,384	8/11/53	Apparatus for cutting tubing	General Motors Corp.
2,648,503	8/11/53	Take-up block for wire drawing	United States Steel Corp.
2,648,535	8/11/53	Apparatus for reduction of iron ore with natural gas	Erskine Ramsay and Robert T. Bagby
2,648,600	8/11/53	Magnetic concentration of iron ore	The United Steel Companies, Ltd.
2,648,602	8/11/53	High strength steel for high-temperature service	Crucible Steel Co. of America
2,648,625-6	8/11/53	Manufacture of electro-tinplated strip	National Steel Corp.
2,648,716	8/11/53	Induction furnace	Thompson Products, Inc.
2,649,002	8/18/53	Seamless tube drawing tool	Donovan P. Gremling
2,649,003	8/18/53	Manipulator for turning stock on a mill table	Birdsboro Steel Foundry & Machine Co.
2,649,099	8/18/53	Apparatus for pickling steel strip	Ernest L. Huff
2,649,403-5	8/18/53	Coke-oven by-product recovery	United Engineers & Constructors, Inc.
2,649,888	8/25/53	Machine for corrugating metal strips	Armco Steel Corp.
2,649,913	8/25/53	Stop device for rod shears	Albert T. O'Neil
2,650,091	8/25/53	Sheet cutting and inspecting means	Armco Steel Corp.
2,650,092	8/25/53	Magnetic separator for sheet feeding apparatus	Caspers Tin Plate Co.
2,650,495	9/ 1/53	Means for measuring and indicating the tension in strip passing between the stands of a rolling mill	Sir James Farmer Norton & Co., Ltd.
2,650,509	9/ 1/53	Wire and tube rolling machine	Donald E. McCray and Donald C. McCray
2,650,599	9/ 1/53	Continuous pickling apparatus	United States Steel Corp.
2,650,603	9/ 1/53	Roll assembly for continuous strip pickling tanks	The B. F. Goodrich Co.
2,650,637	9/ 1/53	Apparatus for straightening coiled sheet metal	Homer D. Paxson
2,650,639	9/ 1/53	Machine for straightening and polishing metal round section bars or tubes	The Union Steel & Manufacturing Co., Ltd.
2,650,824	9/ 1/53	Feeding of ferromagnetic sheets	Hercules Electric & Mfg. Co., Inc.
2,650,888	9/ 1/53	Removal of oxide films formed by strip or sheet rolling operations	Freeport Sulphur Co.
2,650,889	9/ 1/53	Apparatus for inhibiting roll pickup in continuous annealing of steel strip	United States Steel Corp.
2,651,225	9/ 8/53	Device for adjusting and operating guides in the rolling of metals	Per E. Svensson
2,651,515	9/ 8/53	Square checker brick	Albert B. Agnew and Frank J. Rief



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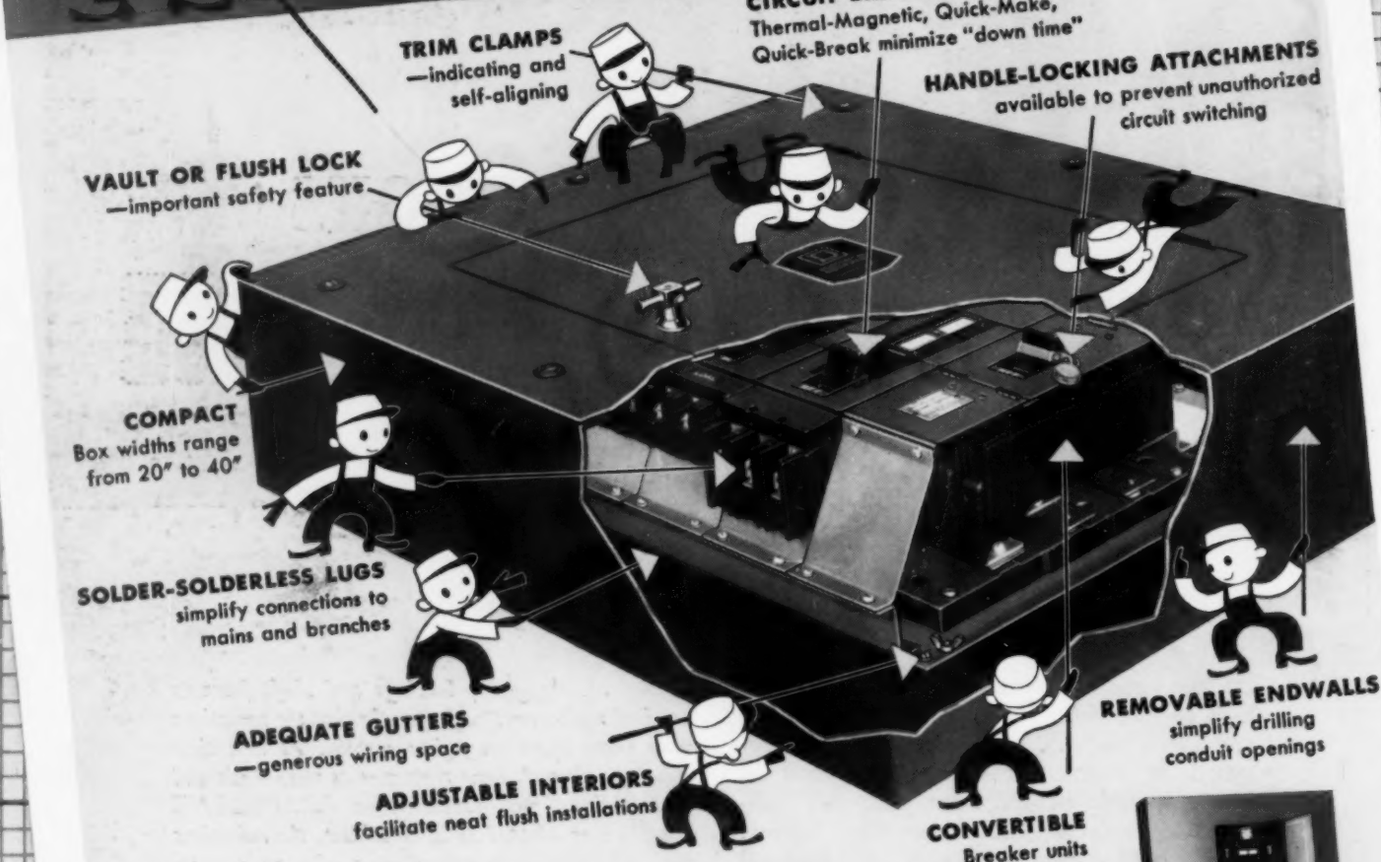

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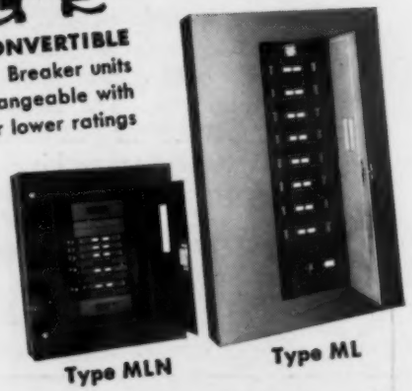

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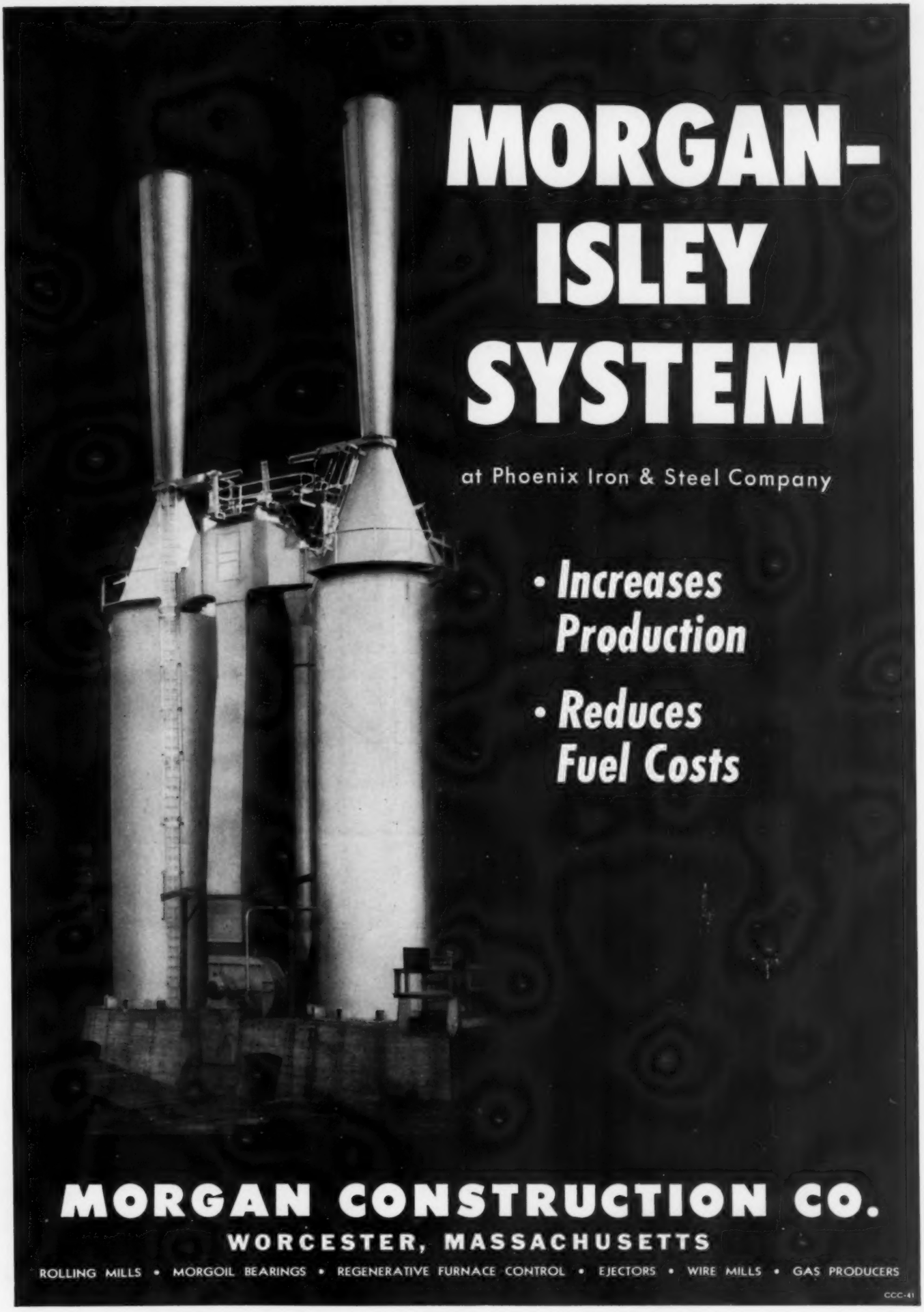
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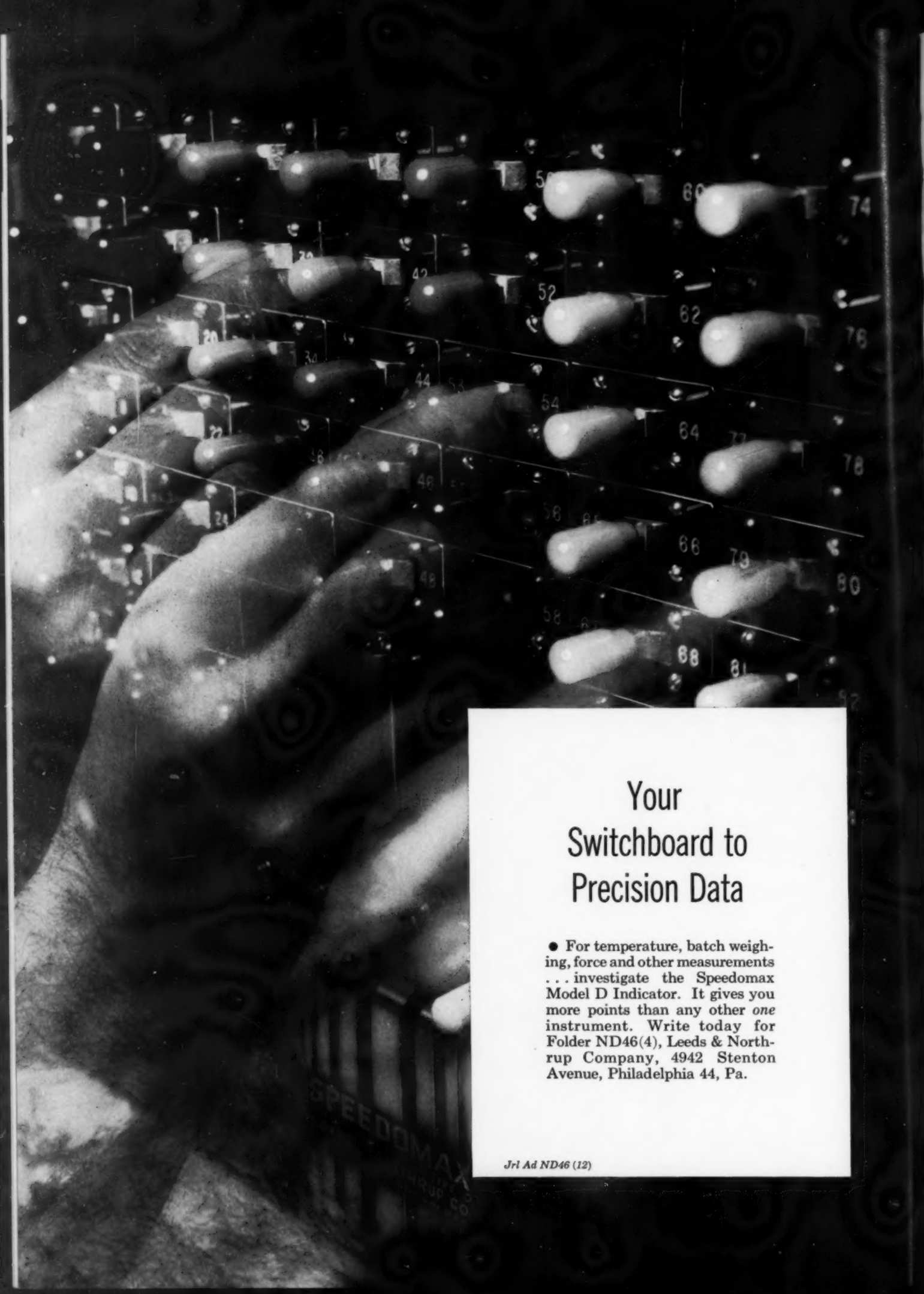
ROLLING MILLS • MORGOIL BEARINGS • REGENERATIVE FURNACE CONTROL • EJECTORS • WIRE MILLS • GAS PRODUCERS
CCC-41



Your Switchboard to Precision Data

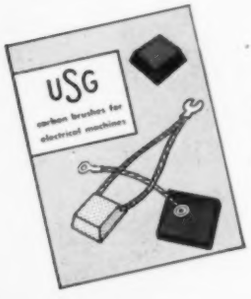
● For temperature, batch weighing, force and other measurements . . . investigate the Speedomax Model D Indicator. It gives you more points than any other *one* instrument. Write today for Folder ND46(4), Leeds & Northrup Company, 4942 Stenton Avenue, Philadelphia 44, Pa.

Jrl Ad ND46 (12)

It pays to buy USG® BRUSHES

For crane motors — mill motors — tin line generators
— for all rotating electrical equipment —
USG BRUSHES are best.

Our brush engineers can analyze and solve those tough application problems. Give our experienced representatives a chance to prove it with a performance test.



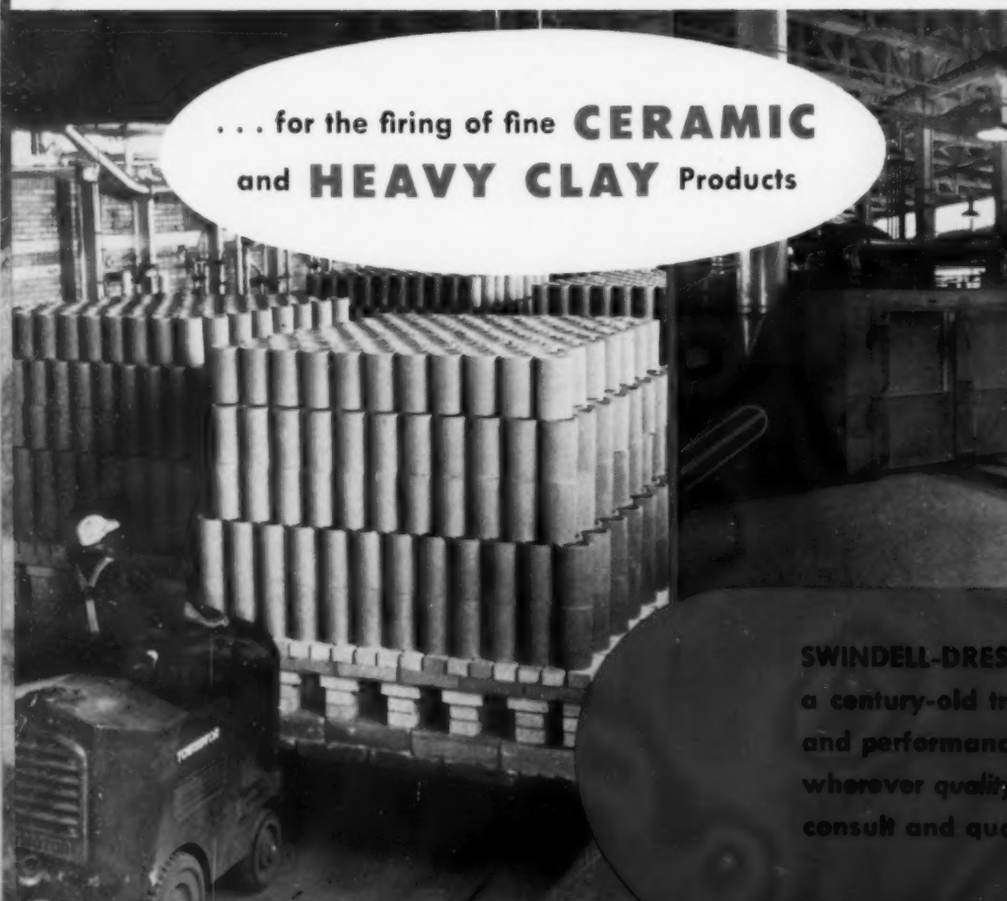
WRITE US TODAY
ASK FOR OUR CATALOG

178

THE UNITED STATES GRAPHITE COMPANY

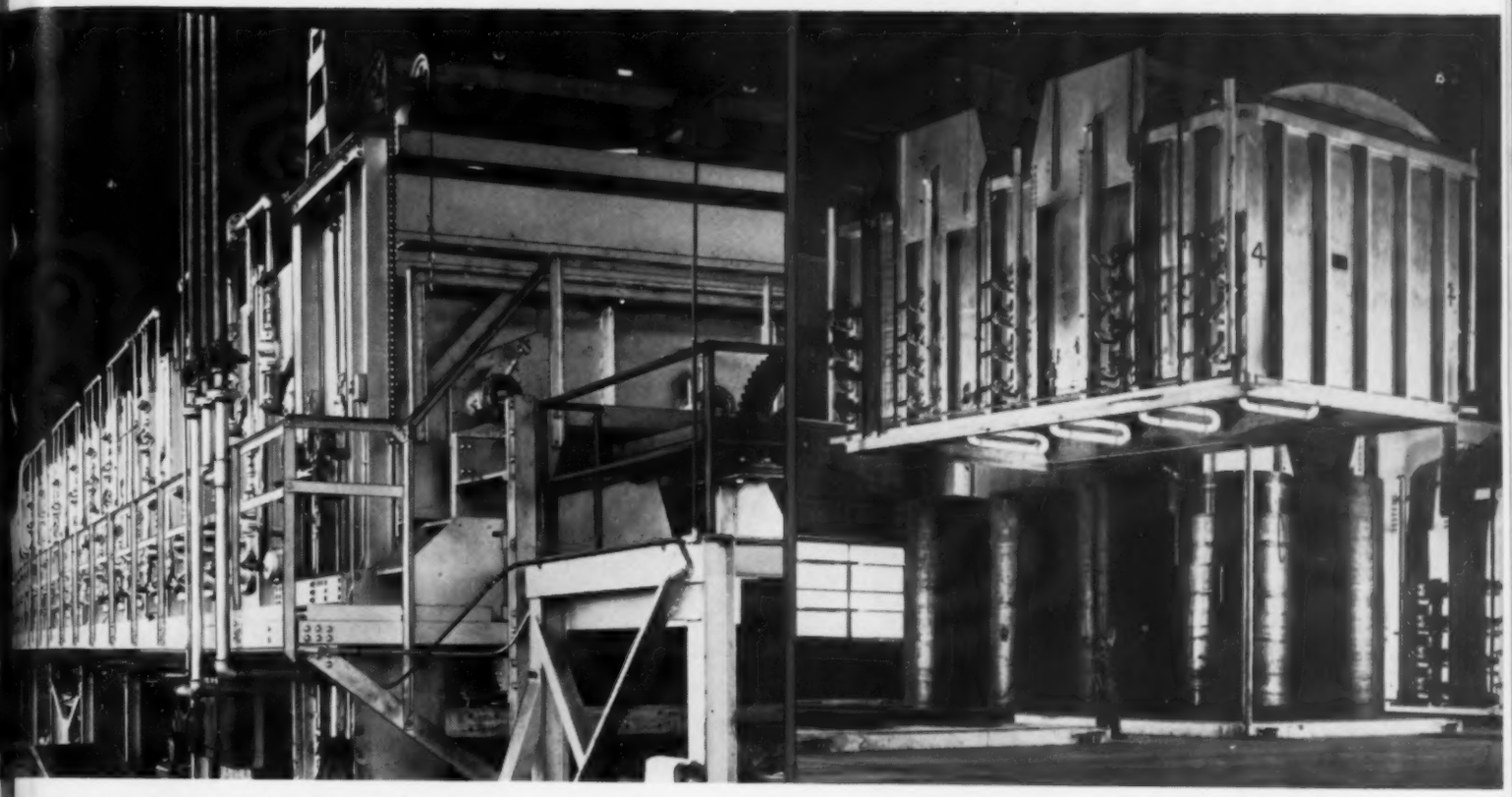
DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

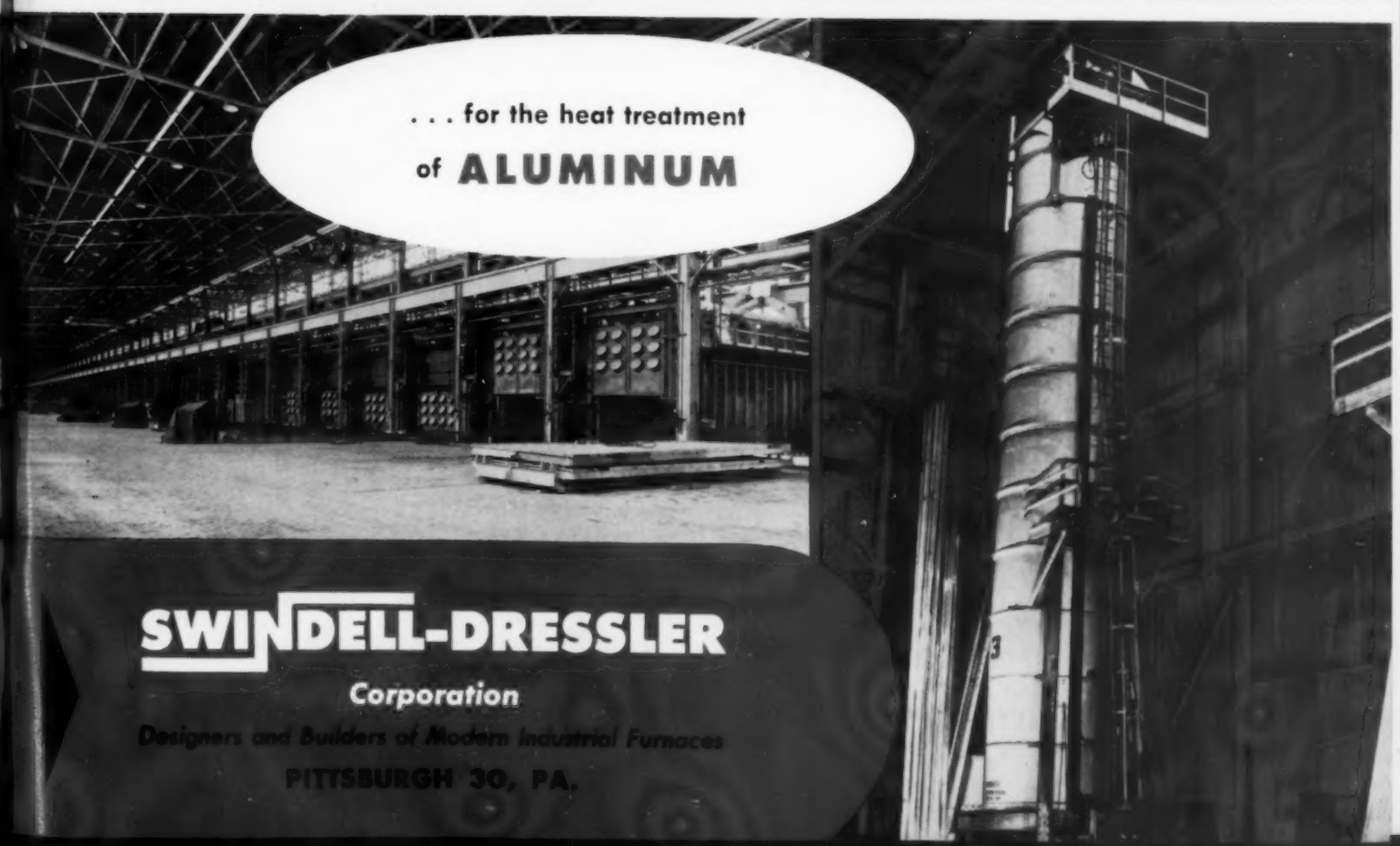
SWINDELL-DRESSLER



SWINDELL-DRESSLER Industrial Furnaces, upholding a century-old tradition of leadership in engineering and performance, are first in acceptance by industry wherever *quality* is the major consideration. • Let us consult and quote on your requirements.

Modern INDUSTRIAL FURNACES





. . . for the heat treatment
of **ALUMINUM**

SWINDELL-DRESSLER
Corporation
Designers and Builders of Modern Industrial Furnaces
PITTSBURGH 30, PA.

Amsco Chains Get Tougher With Use

How AMSCO Manganese Steel Chains Acquire Progressively Greater Resistance to Impact and Abrasion.

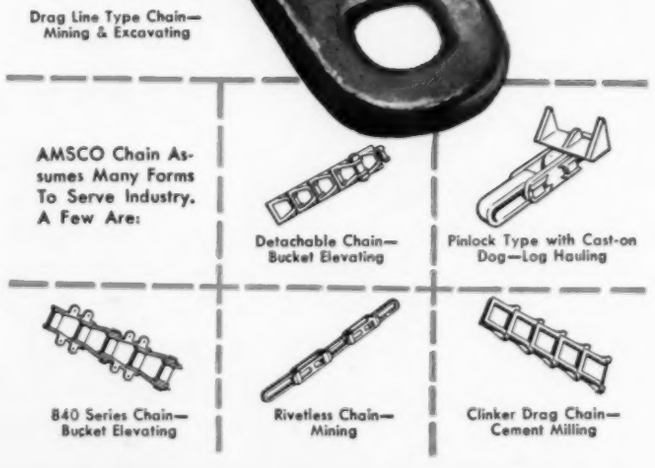
Actual case histories prove that AMSCO Manganese Chains outlast ordinary chains by more than 6 to 1 where impact and abrasion exist. For example, on one conveyor operation, ordinary chain had to be completely replaced every three months. When AMSCO Manganese Steel Chain was installed, only a small fraction of the links were replaced during a test period of over 24 months.

Users of AMSCO Chains benefit by unusual freedom from expensive chain replacement, breakage, maintenance-down-time and other problems caused by impact and abrasion conditions.

AMSCO Manganese Steel Chains have the unique ability to work-harden with use. In rough service, they develop a surface hardness up to 500 Brinell. They also acquire a hard glass-like polish that helps shrug off grinding abrasion. All AMSCO Manganese Steel products — tough when produced — possess the extra-value quality of actually increasing durability with in-use battering and grinding.

AMSCO Chains are made of Manganese Steel —the "Toughest Steel Known." They are produced in many standard and special shapes by American Manganese Steel Division—largest producer of manganese steel for all industry.

If you use chain, and desire a more durable alloy, you are invited to contact AMSCO. There's a good chance we can save you money and provide chains that will outlast your service life expectations.



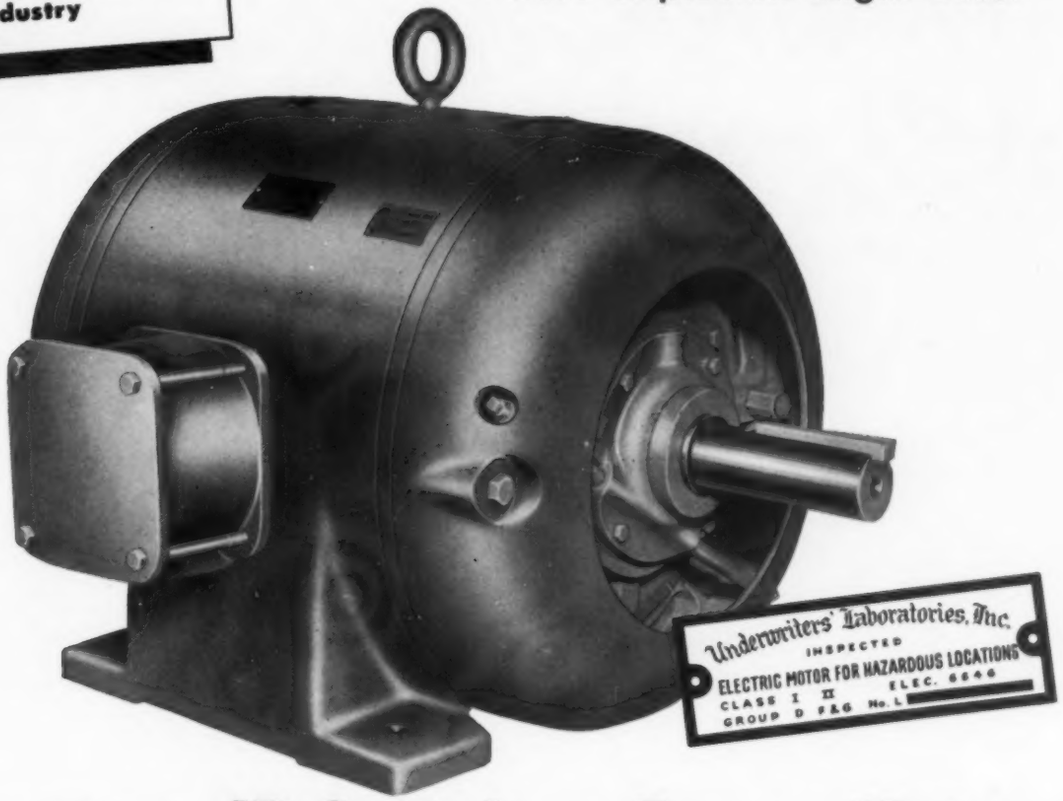
AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
411 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliettette Steel Division, Joliette, Que.
Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.

Wagner
ELECTRIC MOTORS
...the choice of leaders in industry

...where corrosion is a problem
...where explosion might occur



Wagner Type JP Cast Iron Frame Motors

Wagner type JP cast iron frame motors are built for use in chemical plants, oil fields, refineries, steel mills—for any application where corrosive and explosive conditions might prevail.

These rugged motors are totally-enclosed in rust- and corrosion-resistant cast iron. They are fan-cooled by an externally mounted blower, made of non-sparking bronze, that forces air through ventilating passages in the frame. They feature completely protected laminations . . . special varnish treated windings . . . a running shaft seal . . . and an explosion-proof conduit box with machined fits.

A standard type cast iron frame motor (for applications where protection against explosion is not required is also available. Both types are built in ratings from 2 to 250 hp, with either normal or high torque characteristics.

Wagner Bulletin MU-132 gives complete information on these protected motors. A nearby Wagner engineer can help you select a Wagner Motor to meet your most exacting specifications. Consult the nearest of our 32 branch offices, or write us.

Wagner Electric Corporation
EST. WE 1891

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

M53-9

Johns-Manville announces the development of new **SIL-O-CEL 16L** *Insulating Fire Brick...*

Lompoc, California, where Johns-Manville mines and processes diatomaceous silica insulating materials

Combines outstanding physical and thermal properties for furnace service to 1600F

Check these properties of SIL-O-CEL 16L

Maximum service temperature	1600F, back-up or exposed
Approximate density	33-35 lb per cu ft
Transverse strength	60 psi
Cold crushing strength	350 psi
Linear shrinkage	0.7 percent at 1600F
Reversible thermal expansion	less than 0.1 percent at 1600F
Thermal conductivity (Btu in. per sq ft per F per hr at indicated mean temperatures)	0.92 at 500F 1.07 at 1000F 1.22 at 1500F

1—has less than 0.1% reversible thermal expansion at 1600F

2—provides high load-bearing strength

3—for direct exposure or back-up service

Here is a new development of Johns-Manville insulation and refractory research. Its exceptional characteristics provide important savings in furnace construction. Made of diatomaceous silica, Sil-O-Cel* 16L Insulating Brick is light in weight . . . has low thermal conductivity . . . high structural strength. And where furnace linings are subjected to severe heat shock or where high load-bearing properties are needed, Sil-O-Cel 16L offers outstanding performance.

Sil-O-Cel 16L is now available. Samples will be sent on request. Also available without obligation is Booklet IN-115A, which describes Sil-O-Cel 16L and other J-M Insulating Brick and Insulating Fire Brick for service to 3000F. Write Johns-Manville, Box 60, New York 16, N.Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

*Sil-O-Cel is a Johns-Manville registered trade mark

Replaces SIL-O-CEL Natural Brick

The development of Sil-O-Cel 16L Insulating Brick has resulted in the discontinuance of Sil-O-Cel Natural Brick. The outstanding properties of Sil-O-Cel 16L make it the ideal replacement for Sil-O-Cel Natural Brick for back-up use. In addition, the properties of Sil-O-Cel 16L Brick extend its use to exposed service applications.

JM

Johns-Manville *FIRST IN* INSULATION

MATERIALS · ENGINEERING · APPLICATION

2 more examples of THERMIT WELDING ECONOMIES

SOW BLOCK

Replacement of this damaged sow block for a 35,000-lb. forging hammer would have been costly and time consuming — Thermit repaired it quickly and economically.

48" MILL PINION

Weeks of costly idle time were saved by Thermit Welding the 28" neck instead of waiting for a replacement.

Thermit Welding is the answer to repair problems in many different plants—for a wide variety of equipment. Reasons:

- consistently sound welds
- minimum of technical skill required
- speedy repairs
- lower than replacement costs

INVESTIGATE THERMIT® WELDING

always ready to go to work

DETINNING •
THERMIT WELDING •
METALS & ALLOYS •
ARC WELDING—*Materials and Equipment* •
CHEMICALS & ANODES *for Electrotinning* •
CERAMIC OPACIFIERS •
STABILIZERS *for Plastics* •
TIN, ANTIMONY & ZIRCONIUM CHEMICALS •

METAL & THERMIT CORPORATION

100 EAST 42ND STREET • NEW YORK 17, N. Y.

Newark, N. J. • Pittsburgh, Pa. • E. Chicago, Ind.

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Koppers

designs and constructs electric furnace melting shops

MODERN electric furnace melt shops are designed and constructed by our Freyn Department to meet the most exacting specifications.

You may be interested in investigating the possibilities of a "turnkey" electric furnace plant . . . one that is designed and built for the maximum economy of efficient handling and easy flow of materials.

We will be pleased to work up preliminary plans and estimates based on your particular requirements . . . without obligation, of course.

Constructing electric furnace melt shops is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, you can count on Koppers. You are invited to consult with our Engineers and Management.

KOPPERS®

Engineering and Construction Division

KOPPERS COMPANY, INC. · PITTSBURGH 19, PENNSYLVANIA

AFTER 3 YEARS OF RESEARCH AND ON-THE-JOB TESTING

Plasteel

MICA makes the DIFFERENCE

proudly presents the only protected metal

ROOF DECK

with Built-In Vapor-Barrier

- TIME-PROOF
- TROUBLE-FREE
- RUST-RESISTANT

This is how PLASTEEL protects . . .

8 WAYS BETTER

- **VAPOR BARRIER** built into roof deck. No additional layers of felt and tar necessary under the insulation.
- **SOUND ABSORBENT** surface reduces dangerous reverberant noise prevalent where ordinary metal roof deck is used.
- **FIELD PAINTING ELIMINATED** by factory coating of asphaltic-plastics with attractive MICA surface.
- **FULL 24" WIDE COVERAGE,** results in greater coverage and speedier erection.
- **TELESCOPING ENDS** provide for snug nesting of end laps. Gives smooth unbroken roof surface.
- **MICA FINISH** gives good light reflectivity and attractive appearance to underside of deck.
- **NO METAL-TO-METAL CONTACT** possible with asphaltic-plastics coating.
- **NO MAINTENANCE** or periodic painting needed.

PLASTEEL PRODUCTS CORPORATION
WASHINGTON, PENNSYLVANIA

Please send Plasteel Roof Deck details

Company Name.....

.....

Attention of.....
Title

Address.....

City.....*State*.....

Tested and Classified by Factory Mutual Laboratories

ROOFING • SIDING
Plasteel
MICA PROTECTED STEEL
INSULATED PANELS • ROOF DECK

ISE-12-53

PLASTEEL PRODUCTS CORPORATION

OFFICES AND FACTORY

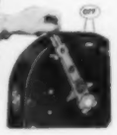
WASHINGTON, PENNSYLVANIA

SALES OFFICES IN PRINCIPAL CITIES

MASTER SWITCHES
for speed control

Operator's cab of river barge unloader

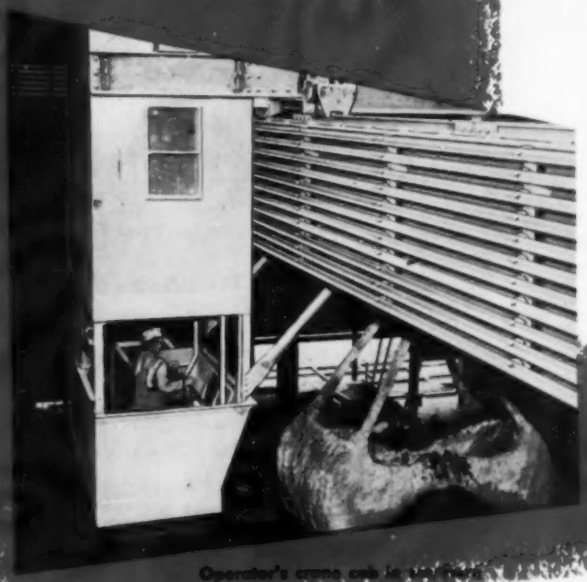
EASY TO OPERATE
A BIG AID TO PRODUCTION



For sit-down, full view cabs or at stations where the operator stands up, several EC&M Master Switches can be compactly grouped within easy reach of the operator without the use of bell-cranks or chain-sprockets. Short in throw and narrow in width, these Cam Master Switches are less tiring on operators—the swifter, easier flow of output means more profit.

Individual speed point notches are readily felt with the off-point most noticeable. Inching between "off" and first point in either direction, too, is easy.

EC&M builds these Cam Master Switches with 2, 3 or 4 cams to provide ample circuits to suit the application.



Operator's crane cab in steel mill

MAKE YOUR OWN COMPACT LAYOUTS with EC&M Bulletin 1190 Cam Master Switches

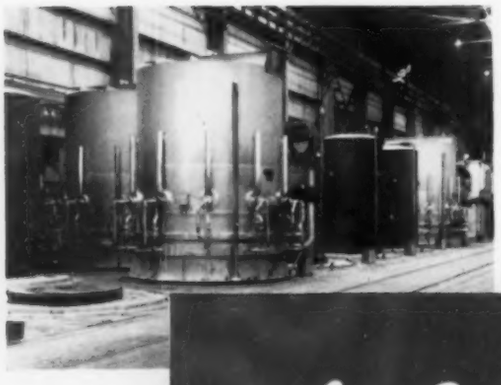
THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

Ten Tons of Steel...

well done coming up!

The chef who babies a steak to just the right degree of savoriness is no more particular or painstaking than the man who anneals the special steels that are in such demand today.

That's why the extreme accuracy and control of annealing found only in the Lee Wilson Single Stack Furnaces is becoming increasingly important to steel makers who are concerned with the quality of their product.



Ever since Lee Wilson developed the present-day method of radiant heating of metals, Wilson engineers have set the pace in annealing equipment design, of which the new Single-Stack Portable-Base Convector Furnace, fitted with high efficiency "O" Tubes is the last word. Details about this amazing new annealing system will be sent to you upon request.

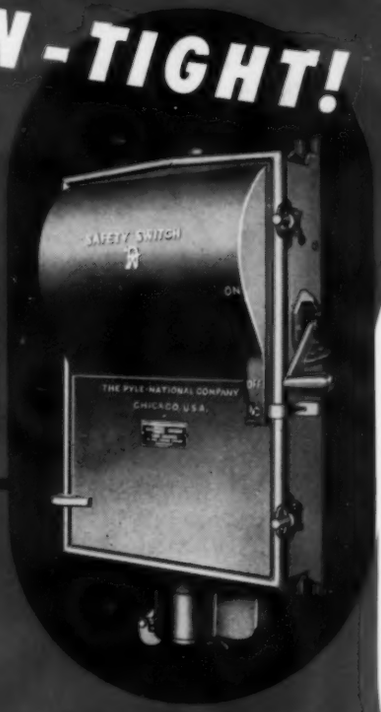
Lee Wilson Engineering Company • Inc.

20005 West Lake Road • Cleveland 16, Ohio

Heavy Duty Safety Switch, and Circuit Breaker

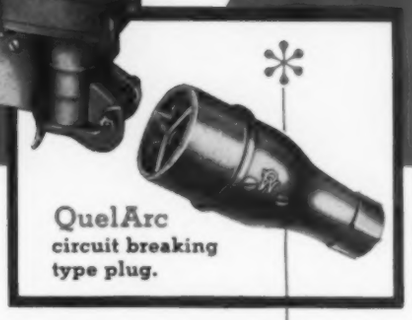
RAIN-TIGHT! DUST-TIGHT!

RAIN-TIGHT SAFETY SWITCHES with receptacle, fusible or fuseless, ratings up to 100 amps, 600 volts . . . without receptacle, up to 200 amps, 600 volts. (NEMA TYPES V, IV and III)



DUST-TIGHT AND RAIN-TIGHT CIRCUIT BREAKERS with receptacle, ratings up to 100 amps, 600 volts . . . without receptacle, up to 225 amps, 600 volts. Dust-tight types for hazardous locations, Class II, group E, F, and G. (NEMA TYPES IX, V, IV and III)

PYLETS



QuelArc circuit breaking type plug.

Designed for Safe, Reliable Operation and Protection of Portable and Stationary Electrical Equipment, indoors and outdoors, under the most severe operating conditions

MUCH LONGER SERVICE LIFE AND LOWER MAINTENANCE COSTS insured by heavy, rust-resisting cast metal construction and rain-tight gasket seals.

COMPLETE SAFETY FOR THE OPERATOR is provided by safety circuit grounding and the interlocking of door and plug receptacle with a quick make and break switch mechanism.

PYLE QuelArc plugs, used with this equipment, are well known industrially, for their unique partitioned construction. Long insulating surfaces from pole to pole, and from poles to ground provide for exceptionally safe handling and long service life.

Consult your Pylet Catalog, Bulletin 1150 for complete listings.

SINCE 1897

THE PYLE-NATIONAL COMPANY
1383 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

District Offices and Representatives in Principal Cities of the United States
Export Department: International Railways Supply Co., 30 Church St., New York.
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PLUGS AND RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • GYRALITES • CONDUIT FITTINGS • MULTI-VENT AIR DISTRIBUTION

Takes the shock around the clock with TIMKEN® bearings on the axles

WHEN tons of steel pour into the molds on these ingot cars, terrific shock loads hit the bearings. Bouncing over rough track also puts shock loads on the bearings. That's why the axles of all the ingot cars in this large Eastern steel mill roll on Timken® tapered roller bearings.

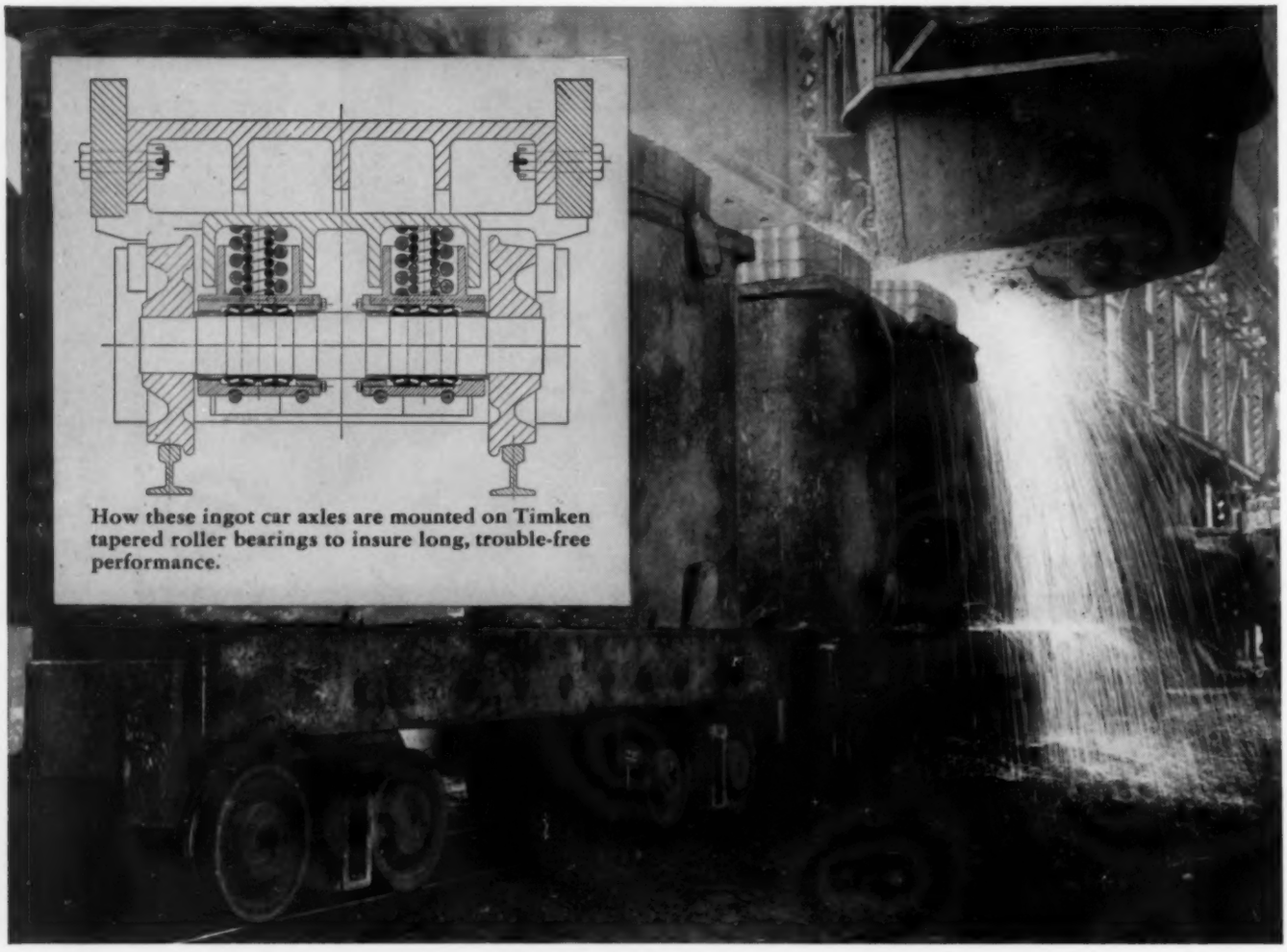
Because case-hardened Timken bearings have tough, shock-resistant cores, they take the shock loads easily, keep the cars ready to roll at any time.

Less hauling power is needed to start the cars, too. Timken bearings' true rolling motion and extremely smooth surface finish practically eliminate friction, cutting starting resistance 88%.

With Timken bearings on the job, the problem of worn-out thrust washers no longer worries mill operators. The tapered construction of Timken bearings takes both radial and thrust loads in *any* combination. No auxiliary thrust devices are needed.

If you build or buy mill equipment, why not get all these advantages? Make sure the trade-mark "Timken" is stamped on every bearing used. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

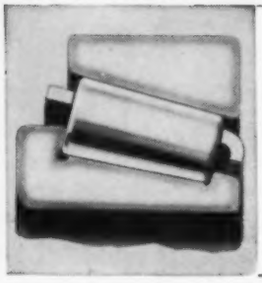


How these ingot car axles are mounted on Timken tapered roller bearings to insure long, trouble-free performance.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



GREATER LOAD AREA

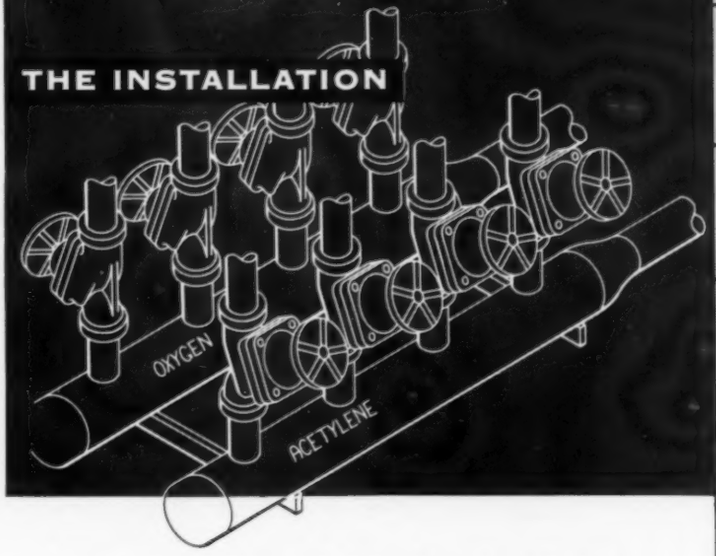
Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

This Valve Stops Hidden Losses

...in Welding Gas Systems, for instance

THE INSTALLATION



In a prominent New Orleans shipyard, with Crane Diaphragm valves listed as "standard operating procedure" for complete oxygen-acetylene system. Shown is typical installation on portable manifold.

VALVE SERVICE RATINGS

SUITABILITY:
100% effective – no leakage

FEATURES:
No seating stress on diaphragm

MAINTENANCE COST:
Zero

SERVICE LIFE:
Installed 2 yrs – long life indicated

OPERATING RESULT:
Big savings on welding gas costs

AVAILABILITY:
Crane Catalog item – No. 1652

THE CASE HISTORY

Costly loss of welding gases was traced to the conventional packed valves formerly used on the system. Leakage through the stuffing persisted despite frequent, regular servicing of stem packing on the valves. This high maintenance cost added to the yard's loss.

The remedy was found in Crane No. 1652 packless Diaphragm Valves, Underwriters approved for the service. These valves stopped the leakage, and not one Crane valve has needed attention since installed more than 2 years ago. Despite continued expansion, the yard's costs for welding gas have been sharply reduced.

THE VALVE

The modern packless valve with Neoprene diaphragm that serves only to seal the bonnet. Its independent disc saves diaphragm wear, provides positive seating on fluid, even should the diaphragm fail. Choose from a wide range of body and trim materials for all kinds of corrosive and ordinary services. Sizes ½ to 6 in.; screwed or flanged ends. See your Crane Catalog, or your Crane Representative.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

SOMEDAY . . . *it will be for real!*

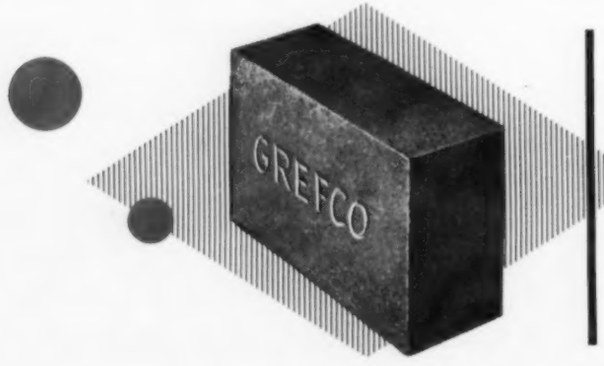
Building with blocks is as much a part of a young boy's life as baseball will be in his teens. Blocks—one on top of the other—to satisfy the typically male urge to create.

As the years roll by, this boy will go on to build bridges or buildings, to make his career in the laboratories of chemical research—or to watch steel being born from ore and earth.

Whatever his future, there will be refractory brick to help him do his job. Blocks of brick to line the furnaces and heat containing vessels—in virtually every step of industry.

There would be no processed raw materials, no production, no living such as we know it but for refractory products which Grefco furnishes in quality and quantity to keep the nation on the move.

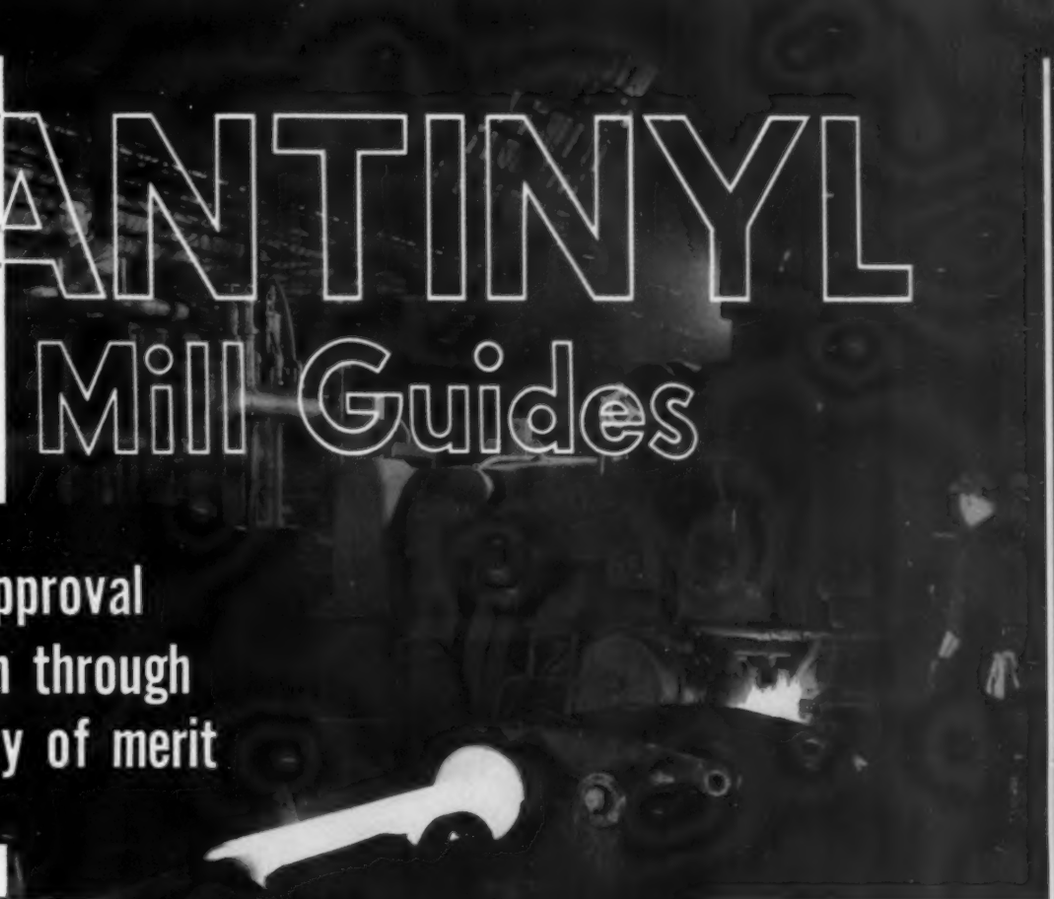
To the boy above, a very Merry Christmas and a great many Happy and Prosperous New Years. In his hands lies the future of America.



GENERAL REFRACTORIES COMPANY
Philadelphia

TRANTINYL Tube Mill Guides

. . . have won the approval of tube mill men through a quarter-century of merit



PIERCING MILL

"When our Seamless Mills were started 20 years ago, the ordinary guide shoes... had to be changed several times in every 24 hours... a problem that had to be overcome to prevent excessive delays..."

"Youngstown Alloy Casting began the manufacture of piercer guide shoes (later given the trade name "Trantinyl") which proved so successful in our piercing mill operation that we have used them exclusively ever since."

"TRANTINYL GUIDES THE STEEL INDUSTRY"

"Guide shoes in a Mannesmann piercing mill are subjected to severe punishment and heat, but our experience has been that a single set of "Trantinyl" alloy guides will stand up in our mill during the piercing of as many as 20,000 hot steel billets."

"Instead of being changed frequently, they will remain in the mill in good condition for as long as one to two weeks at a time. We have never been able to find another guide shoe that will equal this..."

"From time to time we have tried out samples from other manufacturers, but the performance of the "Trantinyl" is so superior that there is no comparison."

"We feel rather kindly toward Youngstown Alloy Casting Corporation because of the quality of the products they have furnished us, which have contributed much toward our success in overcoming mill delays, and toward our success in manufacturing Seamless Tubing of a very high quality."

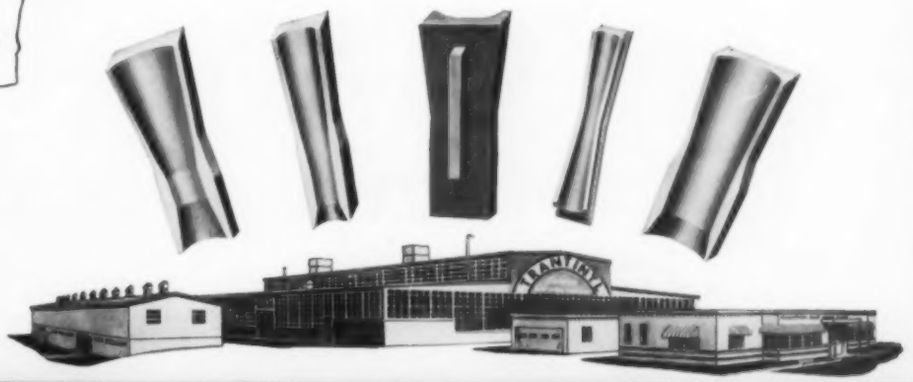
SEAMLESS TUBE MILLS: guide shoes, rolling mill plugs and rolls, piercer points

ELECTRIC WELD TUBE MILL: forming rolls, planishing rolls, tool holders, etc.

ROLLING MILLS: bar, hoop, strip, shape mill guides; and rollers

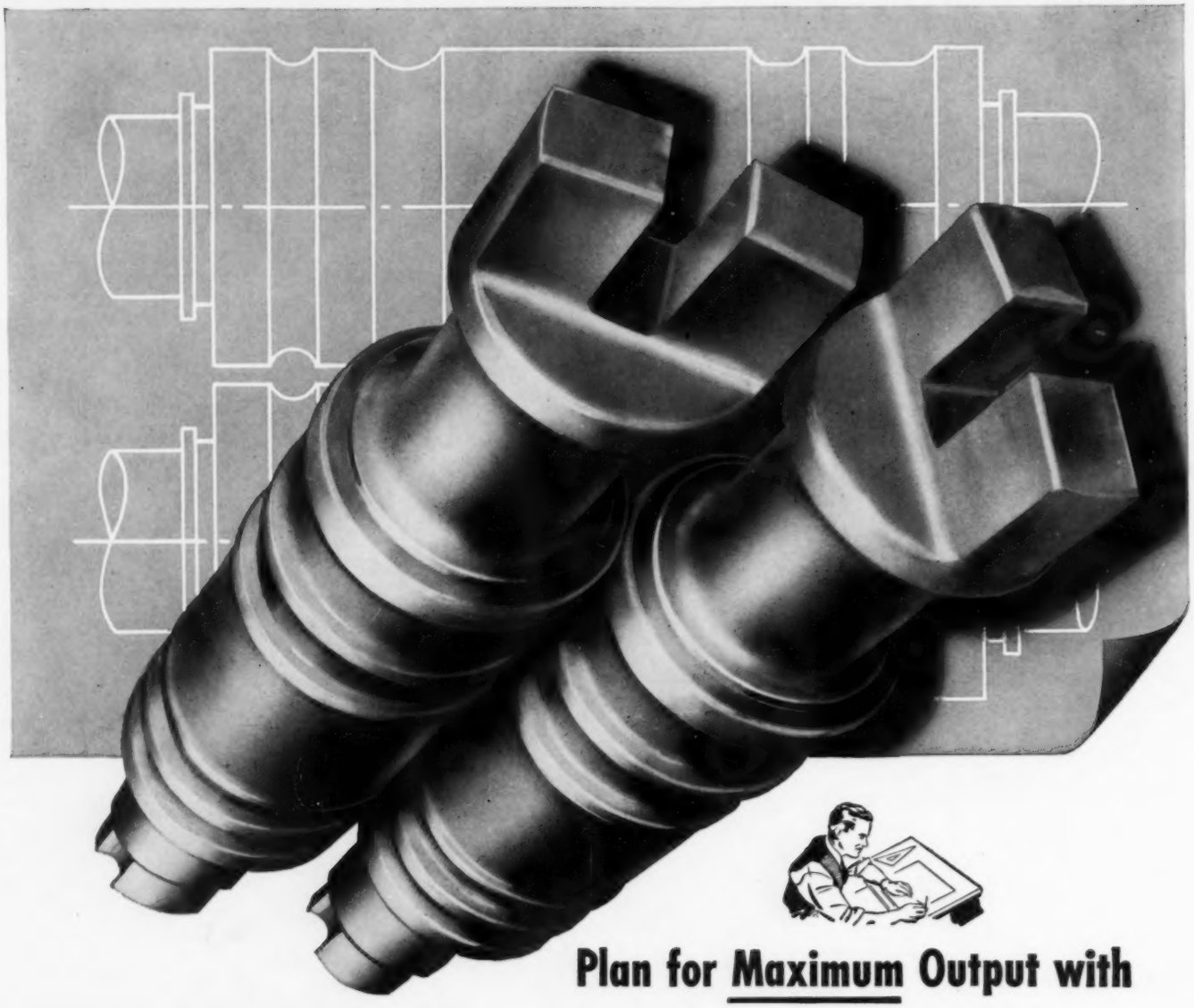
STRAIGHTENING MACHINE GUIDES • HEAT RESISTING CASTINGS

"TRANTINYL No. 1" CAST TO SHAPE



Youngstown Alloy Casting Corp.

Youngstown, Ohio



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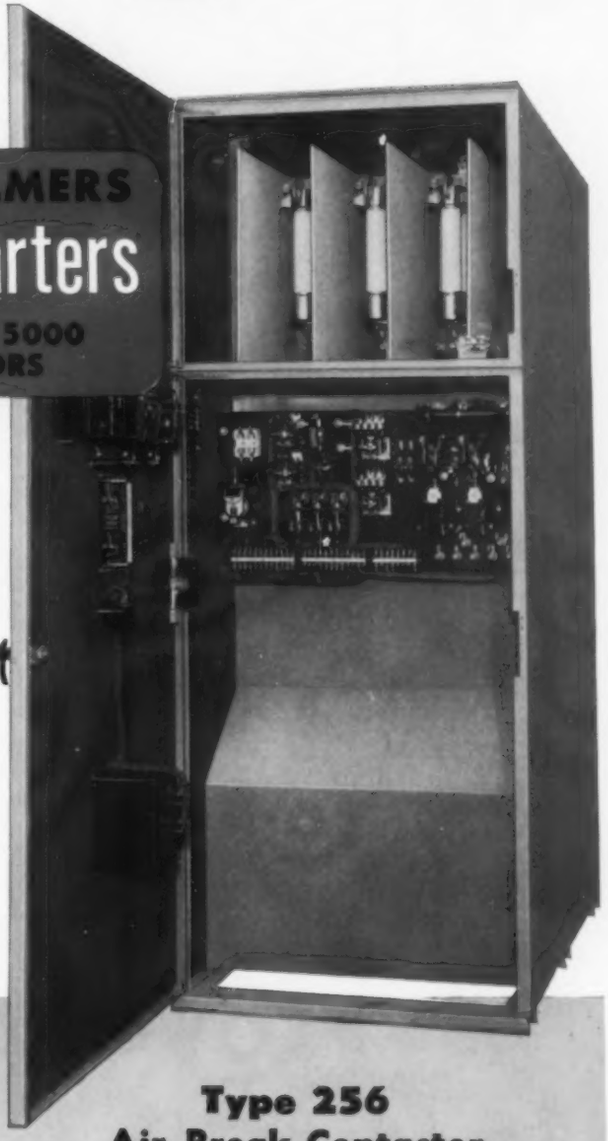

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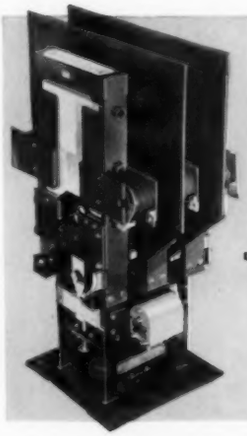

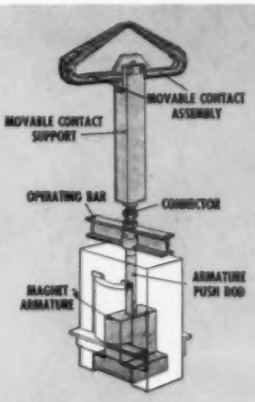

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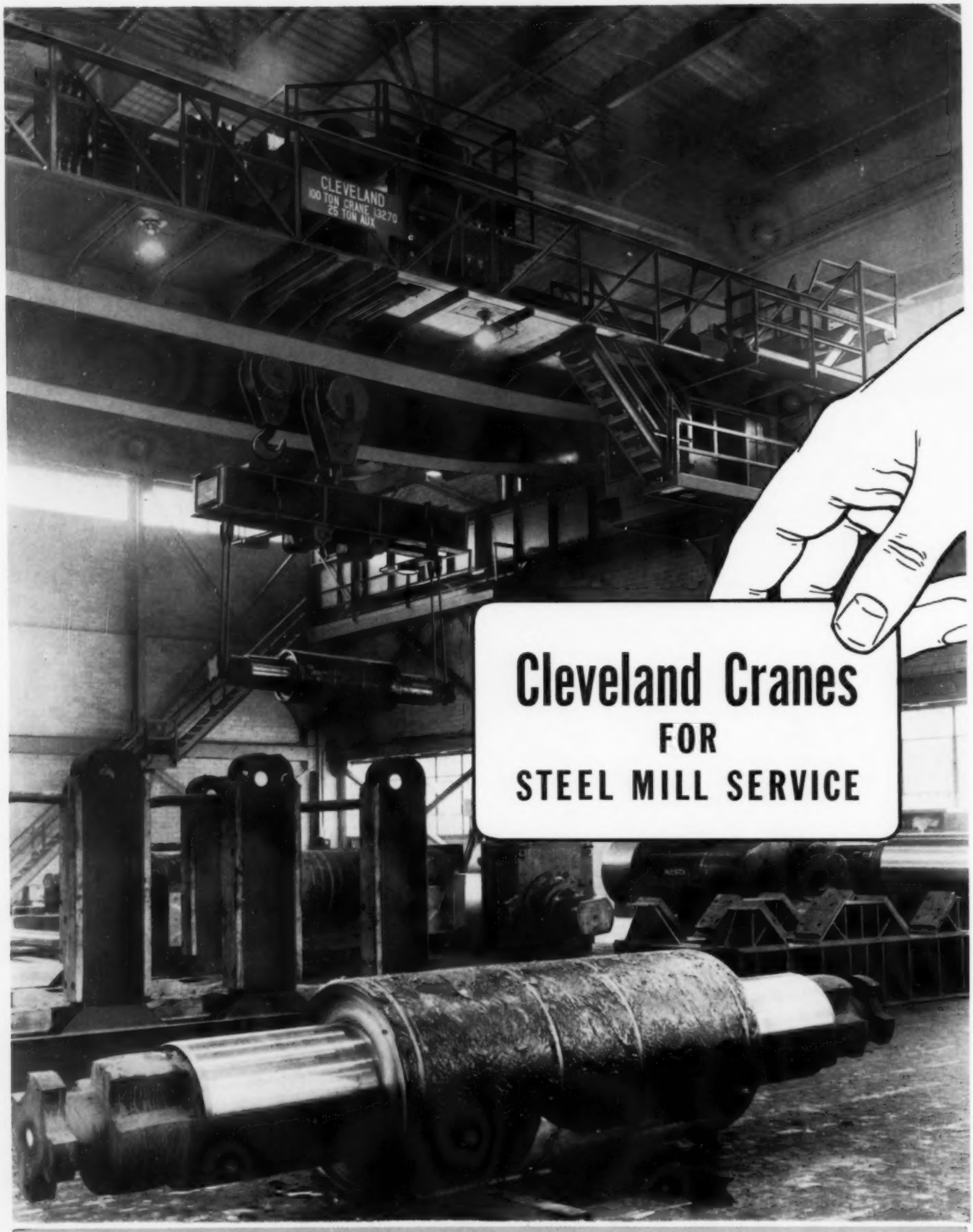

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ACCORDING to the American Iron and Steel Institute, the combined total investment of 44 iron and steel companies, representing about 88 per cent of the total ingot capacity of the United States, was nearly $7,500,000,000 at the start of 1953. This represents an increase of $3,100,000,000 since 1945. Annual steel capacity increased about 30 per cent and book value of common stock 20 per cent during the same period.

The companies long term debt amounted to almost 17 per cent of the total investment.

▲

AUTOMOBILE manufacturers believe that 1954 will be among their five best years. They expect to meet stiff competition with heavier advertising.

▲

A correspondent offers this definition: Research is a straight line drawn from the tangents of several assumptions to the center of a foregone conclusion.

▲

SPURRED by layoffs and reduced work weeks, the United Steel Workers are working seriously on a plan for guaranteed annual wages, to be presented at contract negotiations next spring. This might spell trouble.

If this goes through, how about some scheme for guaranteed annual profits and dividends?

▲

A report by the New York management consultant firm, McKinsey & Co. (not Kinsey) states that most executives think college graduates have an inflated opinion of their ability and importance, expect to receive too rapid promotion, do not work as conscientiously as graduates of 20 years ago, and try to get the most they can rather than thinking of developing a specific skill.

Some of these opinions were accompanied by comments that it may not be the fault of the individual or the college education, but rather, the economic climate of the times.

We have heard men who interview engineering graduates express virtually the same opinions, but blamed the colleges for making students think they are all destined to be managers, with the result that the graduates shun the manual or technician jobs which formerly were the basis of their industry training.

▲

SPEAKING of the Kinsey report, we suppose we must believe its statement that women are really not greatly interested in men, but why do they go on pretending to be?

▲

CARRYING out plans made with Philip Murray, B. F. Fairless, chairman of United States Steel Corp., and David J. McDonald, president of United Steel Workers, are visiting the various plants of the corporation to study labor-management relations at the plant level. It is hoped that this move will help to iron out some of the problems that have plagued relations in the past. We wonder if it will be remembered next summer.

▲

AN item on this page last month stated that your editor, as of that writing, had walked through about half of the steel capacity west of the Mississippi River. Since that time, he has walked through the other half — in all, twenty-two steel plants and one aluminum plant. It was an interesting trip, though at times a bit rugged.

Everyplace, a lot of interest was evidenced in the first western meeting of AISE, to be held in Los Angeles February 15, 16, and 17, 1954, and many western members are urging the establishment of one or two district sections in California. The program for the February meeting is to be found on page 122 of this issue.

▲

A by-product of this trip is an eating acquaintance with some better-than-average restaurants: Maison Blanc in Seattle, the Shadows and the Oyster Loaf in San Francisco, the Windsor Room and the Golden Cock Inn in Los Angeles, Town and Country in Dallas, the Normandie in Houston, and La Louisiane in Tulsa.

▲

NINETY per cent reduction in one pass, with a high degree of accuracy, is said to be possible in a new planetary hot strip mill recently installed in England. The planetary stand consists of 26 work rolls, 2 in. in diameter, equally spaced around each of two 20 in. diameter back-up rolls.

▲

IT'S a surprise to us to hear that an executive is a man employed to talk to visitors so that the other employees have a chance to work. We thought executives were hired to attend meetings.

▲

A report issued by Kaiser Steel Corp. shows that the seven western states will use approximately 6,300,000 tons of steel mill products in 1953 while producing only 5,200,000 tons of ingots.

▲

STEEL product shipments in the first nine months of 1953 totaled 61,848,324 tons, the highest ever attained in a comparable period.

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capacity

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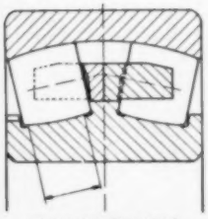
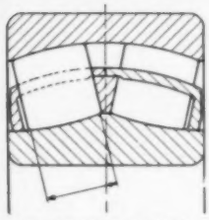


BEARING 22315

This is the Spherical Roller Bearing design originated by SKF *more than 30 years ago.* The cross-section shows how the integral inner ring flanges, and the undercuts adjacent thereto, limit the effective length of the rollers.



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Iron and Steel ENGINEER

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

PASS DESIGN AND ROLLING OF AUTOMOTIVE RIM SECTIONS

By HOWARD H. MORGAN
Assistant Roll Engineer
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

. . . . it is an achievement to have successfully rolled on a continuous mill the intricate shapes which require such exacting rolling tolerances . . . .

▲ MODERN passenger car rims are of the drop-center type, and are cold formed from steel strip. Earlier pneumatic rims, however, used on the heavier passenger cars, were manufactured from hot rolled sections. One early type was a one-piece rim with a transverse cut which allowed the ends of the rim to overlap so that the tire could be slipped on or off. Another type was a two-piece rim consisting of a rim base, unbroken around its circumference, and a removable side-ring used to hold the tire in place. Figure 1 shows these rim sections which were popular 30 years ago. These sections were rolled on a 12-in. hand mill.

The trucks of the same period had solid rubber tires, or at best, pneumatic tires on the front only. The solid rubber tire was mounted on a hot rolled rim base having short thick flanges on either side, and teeth on that side of the base in contact with the rubber tire. One style had teeth of dovetail design, the bending of the teeth being done in the last pass in the mill. Rim bases for solid tires were rolled in widths from 3 to 14-in. inclusive. This type of rim base is being used today on industrial tractors, hand trucks, army tanks, and so forth.

Figure 2 shows the pass design used to roll 4 and 14-in. rim bases for solid tires on a 16-in. mill.

As better pneumatic tires were developed for use on trucks, trailers, and tractors, rim sections were designed to accommodate them. As a result, hot rolled rim sections for pneumatic tires have increased in weight from 3 lb per ft for the old passenger car rim section, to approximately 17 lb per ft for the heavy tractor rim of today.

Pneumatic truck rims require extra strength at vital spots, and for that reason cannot be cold formed from flat stock in the manner of today's passenger car rims. This difference in thickness across the width of the hot rolled rim section in some cases reaches a 2:1 ratio, making the designing of the roll passes difficult.

Hot rolled pneumatic rim sections have always been considered as special shapes, and for that reason they have not been standardized as have structural and some other sections. Due to the keen competition in the rim industry, the manufacturers are often revising some detail of the hot rolled section. Some rim sections are used mostly for replacements and seldom undergo change.

The National Wheel and Rim Association lists four makes of pneumatic truck rims. These are manufactured in two-piece and three-piece rims with flat base, semi-drop center, or deep well style, in various sizes.

Figure 3 shows the pass design used in rolling a repre-

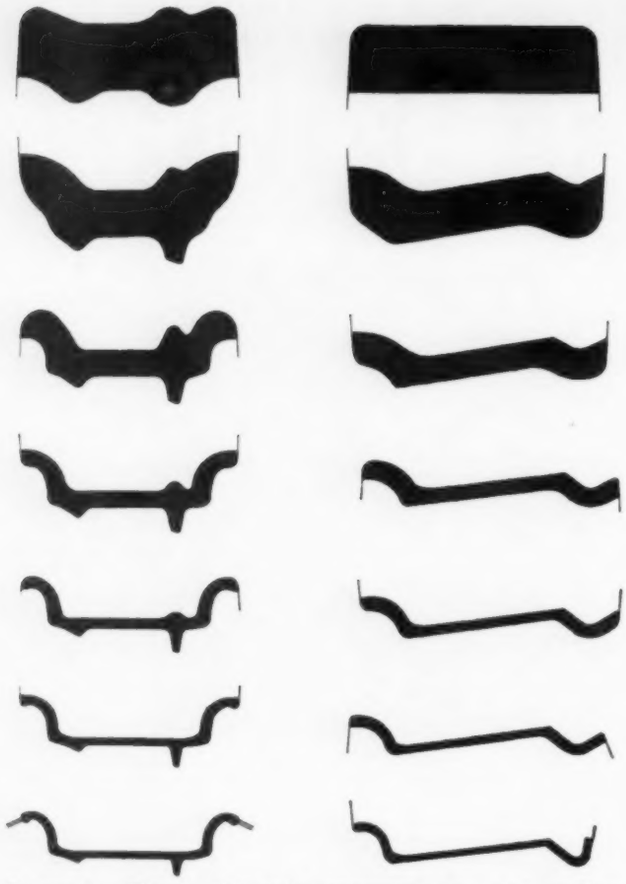
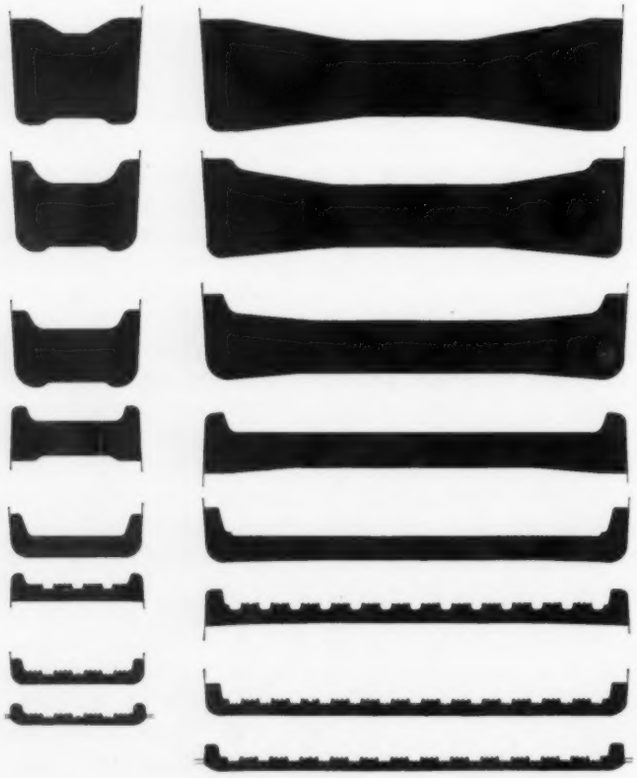


Figure 1 — These old style passenger car rim sections which were popular 30 years ago were hot rolled.

sentative rim section of each make. The two sections on the left were rolled on a 16-in. mill; the two on the right, on a 14-in. mill.

Figure 2 — Sections used for rim bases for solid tires are here illustrated.



We shall return to Figure 3 later, after discussing in detail some of the difficulties encountered in the rolling of rim sections. Each rim section is a special shape, and as such has many dimensions and tolerances that must be met, if a satisfactory product is to be rolled. The standard dimension tolerance on most rim sections rolled by Jones & Laughlin is plus 0.005-in. to minus 0.010-in.; exceptions are: the overall width, the high leg length, and perhaps some other dimensions where it is impractical to hold to so close a tolerance. The manner in which the finishing pass is designed determines to a great extent whether or not extra rolling tolerance is needed on some dimensions.

In some cases, the collar roll must be the top roll; in others it must be in the bottom position, or else the rolls must be parted at the side of the pass. Each case presents a different problem. This can cause considerable trouble for a rim manufacturer who receives a hot rolled rim section from more than one source.

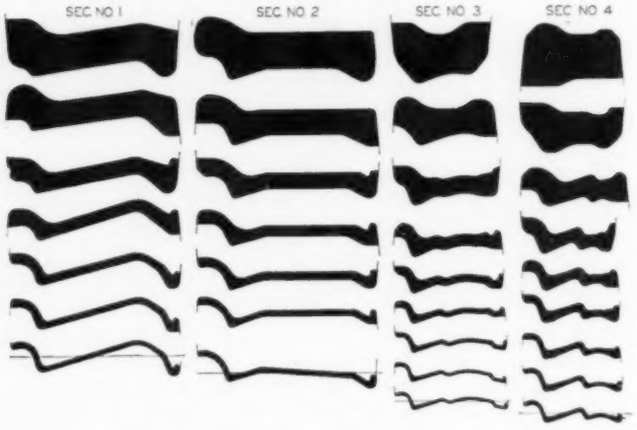


Figure 3 — Four types of hot rolled truck rim sections as listed by the National Wheel and Rim Association.

Figure 4 shows the critical dimensions:

1, 2, 3, 4	which are controlled by the vertical adjustments of the rolls.
"A", "B", "C", "D"	which are controlled by the horizontal adjustment.
"A", "R"	which are affected to some extent by both.

It is obvious that should dimension "B" become heavy due to a shifting of the rolls, or the wear of bearings, then dimension "C" also becomes heavy, and dimension "D" decreases and may produce an overfill at "R". This also affects dimension "A", since all thickness dimensions in the leader pass have been carefully proportioned. The thickening of "B" in the finishing pass has upset the percentage of draft. Less work is being done, and the result will be a decrease in dimension "A". With the movement of the rolls in the opposite horizontal direction, "D" becomes heavy, and the inside surface of the flange may fall away at an undesirable angle. Radius "R" and dimension "A" will also increase under these circumstances. For this particular rim section, the rolling tolerance for dimension "A" is plus or minus 0.031-in. and for radius "R", 0.030 to 0.120-in.

Some rim sections have considerable difference be-

tween the thickness of the web and the thickness of the high leg on the left, and the gutter flange on the right. In this case, the radius "R" can be controlled to a great extent by the increasing or decreasing of the stock from the preceding pass. This is due to the fact that any adjustment has a greater effect, percentagewise, on the thinner web, than on the heavier portions. This effect is more noticeable on the wider sections.

Section No. 4 has a noticeable difference in thickness across its width, but gives some difficulty in rolling. The roll parting is at the center of the rounding on the right edge in the finishing rolls. The inside surface of this head must be filled in the finishing pass without producing an overfill on the outside edge. The straight portion of this inside surface is so short that it is almost impossible to check with gauges. The problem was solved by checking samples with a comparator during the rolling.

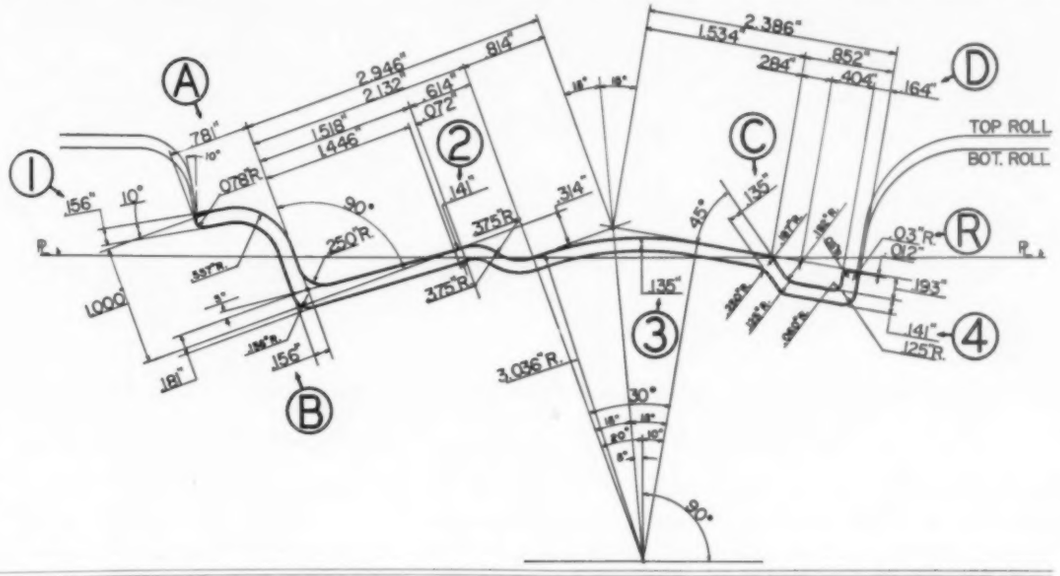


Figure 4 — Drawing shows No. 12 stand finishing pass for a 5-in. rim section.

Returning to Figure 3, it will be noted that section No. 1 has considerable difference between the thickness of the web and the thickness of the gutter flange, making the control of radius "R" not too difficult.

The finishing pass on this section is shown with the bottom roll as a collar roll, and the top roll fitting into it. This results in a weak point on the top roll at the top of the gutter flange, with the danger of spalling. By parting the rolls at a 25 degree angle at point "R", the spalling was eliminated, and it was found that radius "R" could be controlled even though the opening was increased by the change from 5 to 25 degrees.

The great difference between the maximum and the minimum pass diameters of the finishing stand of this type of rim causes considerable slippage at these points. This was very evident, when at one time the customer requested branding on the bar. The location of the branding was at the minimum diameter of the pass and the slippage wiped the characters to the extent that the branding was not legible.

Section No. 2 has been rotated clock-wise to give the necessary taper at the inside of the gutter flange. In so doing, the maximum diameter of the pass in the top roll becomes a weak spot that may not stand the impact of a cold front end.

Sections No. 3 and 4 are rolled on the Jones & Laughlin 14-in. bar mill at Aliquippa. This is a straight-away continuous mill. Section No. 3 does not have a great difference in thickness across its width, and due to the light gauge (0.133-in. web thickness), is perhaps more difficult to roll. It is of interest to note that stands 1, 2, and 3, are continuous and have a common drive. This necessitates using the formula:

(Area) x (average diameter) x (RPM)=Constant.

This constant must be the same for passes 1, 2, and 3.

Passes 1, 2, and 3 are continuous on this section. It will also be noted that the section from 3 stand is much wider than in 5 stand. It is not shown here, but on No. 4 stand, vertical edging rolls are used to reduce the bar ¾-in. in width before entering the No. 5 stand.

In designing the roll passes for a rim section, the basic construction, usually the center line, of the finishing pass, is carried through all passes. It is very important, therefore, that the finishing pass be satisfactory with respect to roll diameters, location of pitch line, degree of taper, etc.

It is often possible to get concessions from the customer which will make a rim section more desirable for rolling. As an example, a rim section was submitted by the customer with a 20 degree bend in the web. It was decided that the web should be bent to 30 degrees, to which the customer agreed. Figure 5 is a drawing of the finishing pass of this section. This gives an angle of 71 degrees 30 min on the side of the high leg of the left, while on the right side, the inside of the gutter flange is at an angle of 78 degrees-30 min with the pitch line. This will insure good surface on the finished bar at these spots, and a reasonable amount of tonnage per roll dressing can be expected.

Another thing to be noted is that the minimum diameter of the top roll is about the same as the minimum diameter of the bottom roll. The minimum diameter on the left side of the pass in the bottom roll is the same as the minimum diameter on the right side. In other words, the section is well balanced.

The length of the high leg on the left side has been determined on the center line for comparison with preceding passes. The left side of the pass has been cut wider than the template in order to take advantage of

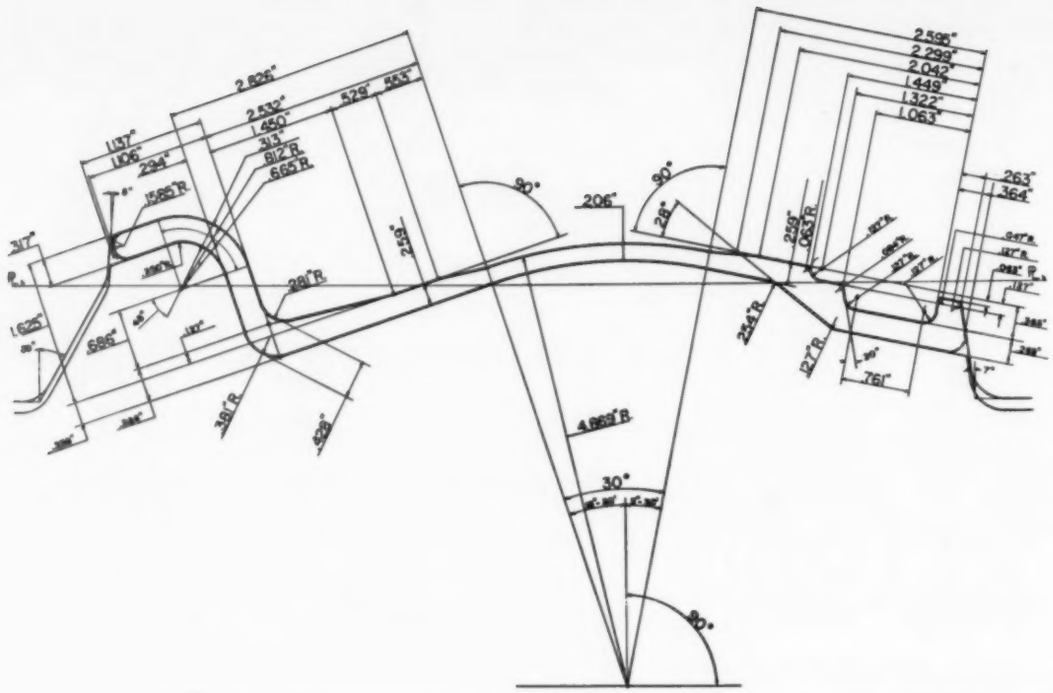


Figure 5 — Drawing shows No. 12 stand finishing pass for a 7.5-in. rim section.

the maximum tolerance on this dimension, should more spread occur than was anticipated. The rolling tolerance provided for the leg length is plus or minus 0.031-in. The side of the pass has been cut away at a 30 degree angle on the left side in order to strengthen the bottom roll. On the extreme right edge of the pass, the dotted radius will be controlled by the size of the radius in the preceding pass. It was decided on this particular section to make the top roll the collar roll in order to control the contour of the flange at the right edge. The height and thickness of this flange are important because a side ring must clear it when mounting or demounting a tire. The extra rolling tolerance is not required at Radius "R" as on the previous finishing pass, but at the dotted radius. The rolling tolerance provided is 0.125-in. R. to 0.250-in. R.

In some cases, the customer may submit a drawing showing a cross section of his finished rim, as in Figure 6. This allows the roll designer a free hand in developing a shape that is best suited to the rolling conditions. In this case the web was bent in a 33 degree arc, the right side—12 degrees from the horizontal and the left side—21 degrees from the horizontal. In addition, the high leg on the left was dropped an additional 2 degrees. This gives the same minimum pass diameters at the left and right sides in the bottom roll. The section is well balanced, with the pitch line passing through the center of the web. Here is another case where the di-

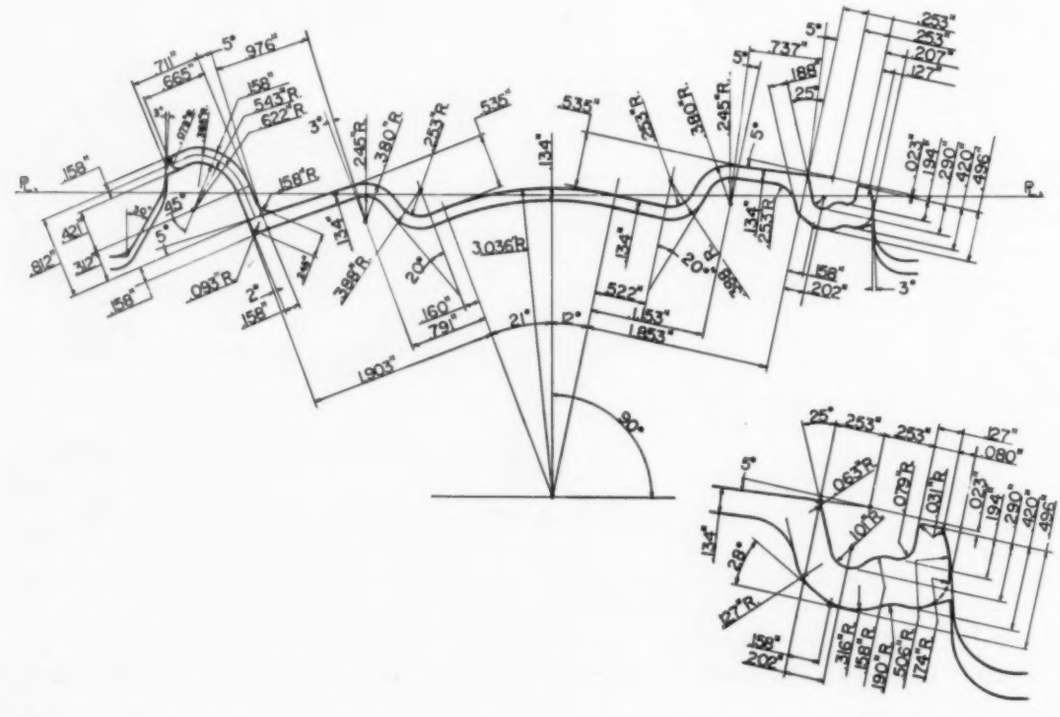
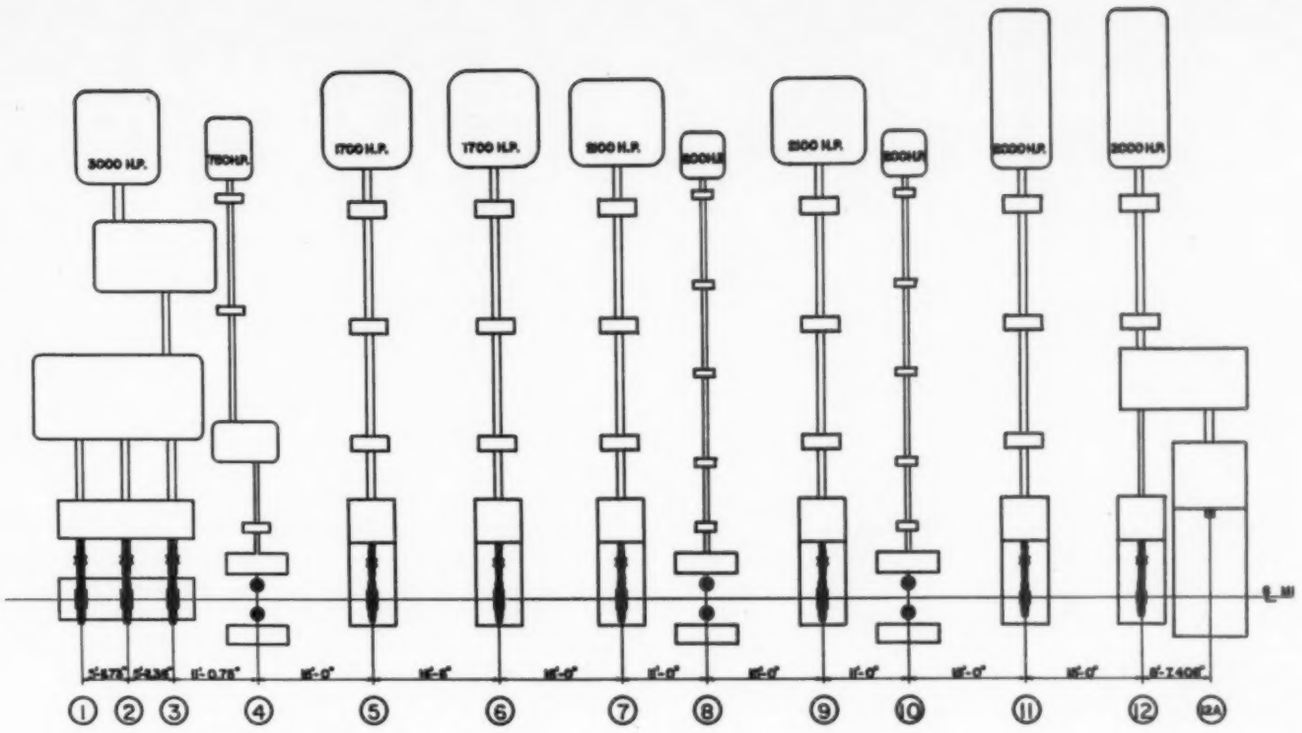


Figure 6 — Drawing shows No. 12 stand finishing pass for a 5.5-in. "F" type, "RHP" rim section.



Stand No.	RPM of Rolls	Pitch diam. pinions in.
1	25.9-46.7	16
2	34.6-62.3	16
3	50-90	16
4V	49.7-118.8	12
5	90-205	14
6	90-205	14
7	150-460	14
8V	140.8-336.5	12
9	150-460	14 or 16
10V	140.8-336.5	12
11	210-680	14
12	260-800	14 or 16
12A	65.5-201.6	29

Figure 7 — Layout of 14-in. continuous mill at the Aliquippa works of the Jones & Laughlin Steel Corp.

mensions of the gutter flange are important, and for that reason the flange is confined in a closed pass with collars on the top roll. The rolling tolerance provided for the high leg length is plus or minus 0.031-in. The rolling tolerance for the dotted radius is 0.093 to 0.172-in. R.

It may be of interest to explain how the preceding passes are designed. The pass drawings are made on vellum so that one can be superimposed on the other; in this way it is possible to observe the entry of the bar into the succeeding pass. This is important because the bar must enter the succeeding pass without shearing, while at the same time the succeeding pass must be properly filled. Needless to say, these drawings must be made as accurately as possible, beginning with the finishing pass and proceeding back through the first pass.

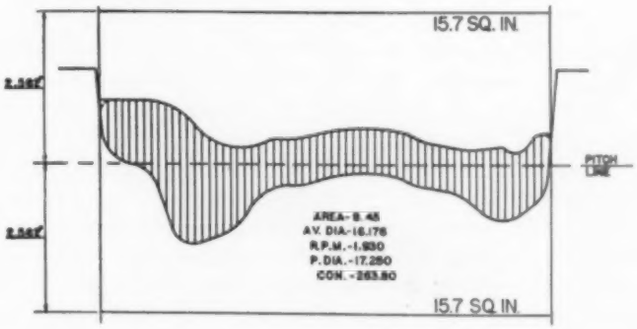
The area of each pass is taken with a planimeter, and the location of the pitch line is determined. Where there is more than one stand on a common drive, it is necessary to adjust areas or even pitch diameters to a common constant, so that:

(Area) x (average diameter) x (RPM)=Constant.

When the drawing for the first pass has been completed, the billet or slab size must be determined. Some of the factors to be considered are: the percentage of reduction in the first pass, how the work is distributed, speed of the first pass, width of the hot billet, expected corners on the billet or slab and the length of the finished bar.

The pass drawings are used to make the roll-turning templates, roll drawings, and the guide pattern drawings. The making of the templates, and the turning of the rolls for rim sections require painstaking work.

Figure 8 — Drawing shows 6.5-in. wide pass roll section in No. 3 stand.



Since the tolerance on most dimensions is plus 0.005 to minus 0.010-in., it requires precision work on the part of the template maker and the roll turner. It is obvious that the rolling tolerance could easily be lost should the templates be off size, or should the roll turner be careless in fitting the template in the roll. Master templates and female gauges to fit over these templates are made for all but the first three passes. This makes the checking of working and auxiliary templates for wear and distortion a simple matter. Depth templates with ears that rest on the collars are used to insure the proper angle of the pass in the roll. All rolls are topped off, in other words the collar roll is turned first and the tongue is fit into the groove or collar roll and at the specified roll setting the templates are fit through the rolls.

The top and bottom rolls for Nos. 7, 9, 11, 12 stands are drilled and tapped to receive the ball thrust bearings that are used when rolling rim sections.

The hot rolled rim sections produced by Jones and Laughlin Steel Corp. are rolled on the 14-in. bar mill at Aliquippa, Pa. This is a straight-away mill of 13 stands. Figure 7 shows the plan of the mill. Stands No. 1, 2, and 3 have a common drive. The remaining stands are independently driven by variable speed motors. No. 12-A is a universal stand, used when rolling Junior beams and tie plates. No. 12 and 12-A stands are never used in tandem. Stands No. 4, 8, and 10 are vertical rolls. The length of this mill from the center line of No. 1 stand to the center line of No. 12 stand is 137.5 feet. The finishing stand (No. 12) has a top speed of 800 rpm. The cooling bed is of the rack type, and is 250.5 feet in length.

The troughs between stands on this mill are only 18-in. wide, and the succeeding pass is entered at high speed. For this reason, a good delivery is essential, and requires not only the proper proportioning of the work in the various passes, but also that the gauge of the bar in each stand be right.

When beginning a rim section rolling, a bar is cobbled between stands in order to check gauge, cross section, and so forth. This is done by raising the up-looper, and delivering the bar onto the mill floor.

Rim sections are finished at about 1450 fpm, or 350 rpm. At this speed, there is an elapsed time of 25 seconds from the entry of the billet in No. 1 stand, and the entry of the same bar in the finishing stand.

Top and bottom bell-mouth entry guides are used in a guide box with set-screw adjustment when rolling rim sections. This has proven more satisfactory than the side entry guides which often collapse the section. Thrust bearings are used on the top and bottom rolls of stands No. 7, 9, 11, and 12, and have proven very satisfactory.

On a mill of this type, with the bar in as many as six stands simultaneously, there is the possibility of pulling between stands. This is prevented by up-looping between all stands but the first three.

DISCUSSION

PRESENTED BY

FRANK F. ZIPF, Superintendent Roll Department, Bethlehem Steel Co., Johnstown, Pa.

E. E. BRAYSHAW, Sales Engineer, Continental Foundry and Machine Co., Pittsburgh, Pa.

A. M. CAMERON, Superintendent of Rolling Mills, Atlas Steels, Ltd., Welland, Ontario, Canada

WILLIAM H. MOHLER, Superintendent Roll Department, United States Steel Corp., McDonald Mills, Youngstown, Ohio

HOWARD H. MORGAN, Assistant Roll Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Frank F. Zipf: I am interested in how the author divided his section to even up his draft so that he does not get side sweep, because side sweep would be very critical in a mill of this type.

E. E. Brayshaw: Mr. Morgan has presented an interesting paper on one of the most intricate of the rolled shapes. It is an achievement to have designed rolls and to have successfully rolled, on a continuous mill, these special, intricate shapes which require such exacting rolling tolerances.

As presented in the paper, there are many factors which must be closely controlled in order to insure an acceptable finished product. For sections having the intricacies of shape found in automobile rims, side rings, sash, piling, etc., guide design plays a most important role. I recall one particular instance where, despite the extreme care and caution which had been exercised in the design of the passes for producing one of these rim sections, due to faulty guide design it was impossible to roll the section. After installing guides of proper design, which resulted in perfect delivery of the bar from the various passes, the section was rolled to all required tolerances without further difficulty.

It has been pointed out that the development of the gutter flange is important. Since this is true, then it is necessary that the designer keep in mind that as the inside taper of the gutter flange (see Figure 4) approaches perpendicularity with the horizontal axis of the rolls, the side work on the flange (particularly in the finishing pass) must not be too great or, due to the small taper, shearing will develop on the inside of the flange.

Another point which must be considered in the design is the small radius: For example, the 0.060-in. radius shown in Figure 4. A small radius at the junction of the gutter flange and web, adds to the difficulty in producing automobile rims. A small radius and a minimum taper on the gutter flange is conducive to setting up a wiping action which results in the formation of a lap.

In discussing section No. 2 in Figure 3, Mr. Morgan commented on the placement of the pass in the rolls so as to give the necessary taper on the inside of the gutter flange. I would like to add further that many of these rim sections are rolled in an arched shape. Unfortunately, in order to produce the required gutter, it is often necessary to make this arching greater than actually desired by the customer. To attempt to roll the section in a more flat position would necessitate undercutting which would set up an impossible rolling condition.

Mr. Morgan spoke of "average diameter" with reference to determining the constant for the three continuous stands on a common drive. I presume he means the working diameter of the rolls. What method is used for determining this diameter? Is it the W. Dahl method which employs the area of the pass and pass width? I know this method is used extensively in shape rolling.

In discussing section No. 4 in Figure 3, the author stated that the bar from stand No. 3 is edged in the vertical edging rolls of stand No. 4. Are these edging rolls shaped or do they have plain cylindrical surfaces. If the rolls are shaped, do they follow the contour of the sides of the bar?

In thinking of the 14-in. continuous mill at Aliquippa on which these rim sections are rolled, I recall that this mill is equipped with hot straighteners at the cooling bed. Are these straighteners used in the production of rims, or are the bars allowed to cool before straightening?

A. M. Cameron: There is one question I would like to ask. I recall when rim sections were becoming very popular and also highly competitive, that the rim manufacturer took the roll designers to task, trying to get a section which would be thin and still get close tolerance. The problem was to design rolls that would have some wear, as well as some life, and at least have some angles of opening. I notice the section as shown in the illustration is somewhat different from the shape that is actually used to make the rim. I would like to ask, if there is any cold forming, other than forming the rim section into the circle?

W. H. Mohler: Mr. Morgan and his associates deserve credit for the great amount of ingenuity required to roll rim sections on a continuous mill. Besides the close calculations in roll passes, the precise turning of the rolls and exact setting of roll speeds, there are other difficulties to overcome in rolling these sections. I am referring to the intricate adjustment of both rolls and guides required by the rollers in starting. The roller on this type of mill is at a very distinct disadvantage in observing what is occurring in the rolls in starting the section. As Mr. Morgan stated, to examine the section for any particular pass requires that the looper be set and the cobble be thrown out on the floor for examination. This may mean it is necessary to throw cobbles out of each of the shape passes, in order to get a good picture of what happens in the rolls. It is more simple and more convenient to make these observations on a cross country or table mill where the bar may be visually examined as it enters or leaves the stand, or pieces may be cut off for closer measurement without having to cobble the bar. Mr. Morgan's mill records indicate after they once get this continuous mill started, the production is high. Of course, this no doubt compensates for the extra time spent in starting the order. I would like to ask Mr. Morgan a couple of questions. First, just what is your rolling rate per hour on the rim sections of this type? I would also like to have a comment on whether the use of roller side guards is important on your continuous mill or not. My experience rolling rim sections indicates there are a lot of occasions where we require the roller side guards on the delivery side to take care of some of the thrust that Mr. Zipf was referring to a few minutes ago.

Howard H. Morgan: In answer to Mr. Zipf's question: I assume he is referring to the delivery of the bar from the mill. We carefully proportion all thickness dimensions, possibly back to No. 3 stand, when designing the passes. The thickness dimensions of passes Nos. 1, 2 and 3 are not proportioned, but the passes are bisected and the area of the left and right sides taken, the purpose being to distribute over the three passes the unequal drafts which invariably occur.

Maintaining the gauge as set up for each pass also contributes to good delivery when rolling rim sections. The ball thrust bearings aid in this since they require practically no adjustment throughout the rolling.

In answer to Mr. Cameron's question regarding the cold forming done by the customer, the web is flattened on those sections having an arched web. In one plant where heavy rims were being fabricated, the web was flattened with a press. In another plant where light rims were being manufactured, the web was flattened during the bending operation when the circle was formed. At the present time, the cold forming is limited to the flattening of the arched web.

In answer to Mr. Brayshaw's question regarding the shape of the edging pass in the No. 4 vertical set: the edging pass is made to conform to the contour of the sides of the bar from the preceding No. 3 stand.

Figure 8 shows the method used to determine the average diameter. Ordinates are drawn through the pass. Obviously, the closer the ordinates, the more accurate will be the results. The length of each ordinate from the pitch line to the upper and lower profiles of the pass are measured and the average taken. This value is doubled and then subtracted from the pitch diameter, the result being the average, or working diameter.

This figure also shows the method of determining the location of the pitch line. A horizontal line is drawn at random above the pass, and vertical lines are drawn tangent to either side of the pass. The area is determined between these lines and the upper profile of the pass. A horizontal line is now drawn below the pass and this line is moved until the area between these lines and the lower profile of the pass is the same as that above. The half-way point between the two horizontal lines is taken as the location of the pitch line. This method has given good results on rim sections.

In answer to the question of straightening, the rim sections are straightened in a 9-roll straightener as the bars come off the cooling bed.

In answer to Mr. Mohler's question, the cobbles are taken beginning with No. 3 stand, and the gauge is corrected for each stand. The billet may be cut into several pieces so as to cut down the scrap loss when starting a rolling.

I do not have the average rolling rate per hour for rim sections, but I do have the record tonnage which is the best record on a rim section. This particular record of 679 tons rolled in an 8-hour turn was made on a 6-in. rim section.

Roller side guards are used on the delivery side of all but the first three stands to prevent the scratching of the edges. The roller side guards are especially helpful on the finishing pass where any scratching is highly objectionable.

THE PLACE OF THE GAS TURBINE IN INDUSTRY

By T. J. PUTZ
Manager, Gas Turbine Engineering
Westinghouse Electric Corp.
Philadelphia, Pa.

. . . . when the problems of burning blast furnace gas have been solved, the gas turbine unit should find a place in the steel plant . . . .

▲ THE development of the gas turbine power plant in this country has now reached the stage where this type of prime mover merits serious consideration as a power and air supply source in the steel and iron industry.

Wartime developments in aircraft gas turbines have accelerated the necessary research on high temperature materials, aerodynamic design of compressors and the high heat release combustors. Our company started work on industrial gas turbine units in the late 30's but suspended this work in 1941 to concentrate solely on jet engines for aircraft propulsion. Work was resumed on development of industrial gas turbines in 1944. The

Figure 1 — Three cycles are in common use in gas turbine power plants.

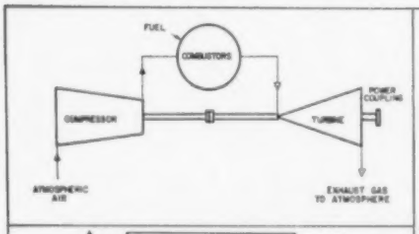
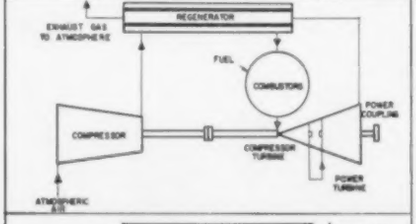
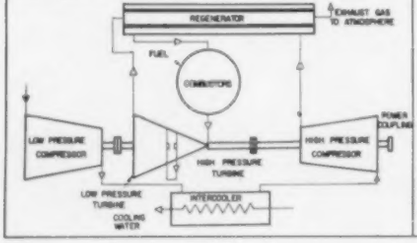
OPERATING CYCLE DIAGRAM	PLANT DESIGNATION	RATINGS AVAILABLE FOR ELECTRIC POWER GENERATION	RATINGS AVAILABLE FOR MECHANICAL DRIVE	APPLICATIONS
	SIMPLE OPEN CYCLE	1250 KW 5000 KW	1800 HP 7000 HP	BASE LOAD OPERATION WHERE FUEL IS INEXPENSIVE. PEAK LOAD, STAND BY AND END OF ELECTRIC PLANTS WHERE WATER IS SCARCE OR EXPENSIVE. MOBILE OR SEMI-PORTABLE PLANTS WHERE EXHAUST GAS CAN BE UTILIZED FOR FEEDWATER HEATING, STEAM GENERATION OR PROCESS.
	COMPOUND OPEN CYCLE WITH REGENERATOR	3500 KW	5000 HP	DRIVE CENTRIFUGAL COMPRESSORS FOR NATURAL GAS TRANSMISSION. DRIVE PUMPS, COMPRESSORS, BLOWERS, ETC.- GENERAL INDUSTRIAL PLANTS ELECTRIC POWER GENERATION WHERE 3500 KW CAPACITY IS REQUIRED.
	COMPOUND OPEN CYCLE WITH INTERCOOLER AND REGENERATOR	15,000 KW	20,000 HP	INDUSTRIAL AND CENTRAL STATION PLANTS. BASE LOAD OPERATIONS WHERE HIGHEST THERMAL EFFICIENCY IS REQUIRED.

Figure 2 — This gas turbine is driving two centrifugal compressors.

success of this development has led to the construction of additional new research and manufacturing facilities.

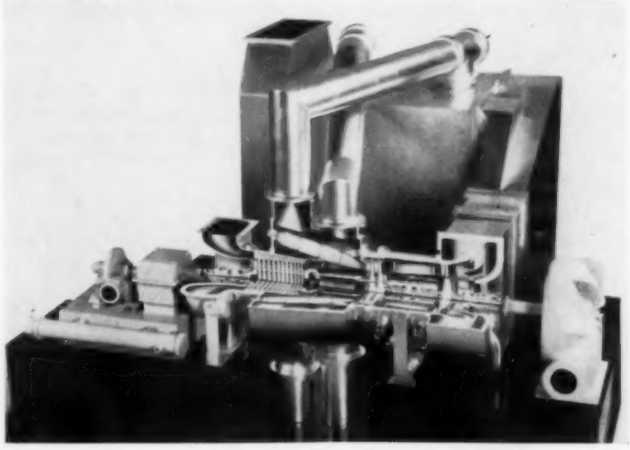
The industrial gas turbine power plants built or in process of manufacture by us are tabulated on Figure 1. These plants can be divided into three general type classifications.

SIMPLE OPEN CYCLE

In this type plant we have built two sizes, namely 1250 kw and a 5000 kw. The first 1250 kw machine was built and shop tested in 1946. In 1949 this prototype was modified for gas line pumping driving a single stage centrifugal compressor and placed in main gas transmission pipeline service. It was the first industrial gas turbine unit to go into commercial service in this country, and at this time has accumulated in excess of 13,000 hours of "on the line" operation. It is fitted with dual fuel nozzles and can be shifted from liquid to natural gas fuel without shutdown.

Two similar units have been installed in our demonstrator locomotive. Their small size has allowed side by side mounting in the locomotive. The units have operated with both diesel and residual fuel oil.

Figure 4 — Model shown is for a compound open cycle with regenerator.



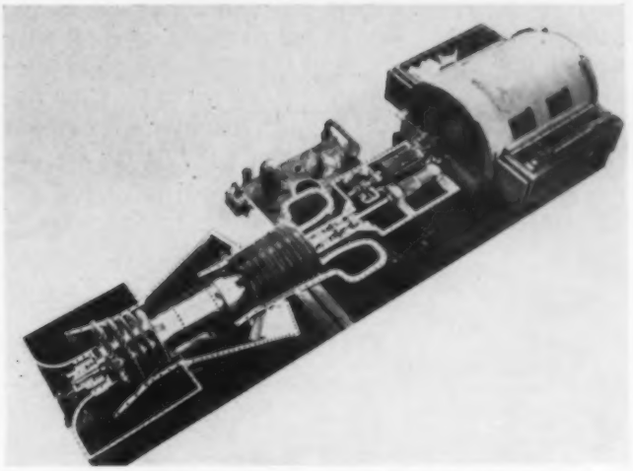


Figure 3 — Unit shown is rated at 5000-kw.

Figure 2 shows another application of this unit driving two centrifugal compressors. It will be trailer mounted and forms a portion of a complete portable oxygen plant.

The second unit that has been developed of this type is a 5000-kw size. Figure 3 is a photograph of this larger unit taken during shop erection. This unit was placed in service on the West Texas Utilities System in November 1952, burning natural gas fuel.

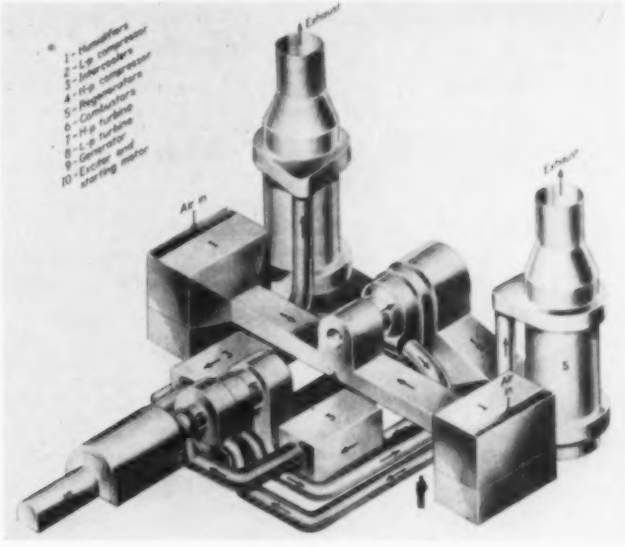
Two additional units of this type are now under construction. One of these is to be rail mounted, and together with a transformer control car it will constitute a portable emergency power unit.

Efficiencies for the simple open cycle plant vary from 16 per cent for the 1250-kw unit to 20 per cent for the 5000-kw unit.

COMPOUND OPEN CYCLE WITH REGENERATORS

The second type plant that has been developed is the compound open cycle with regenerators. With this arrangement some of the waste heat in the turbine exhaust gas is recovered thereby increasing the overall

Figure 5 — This model is of a 15,000-kw unit which is now being manufactured.



thermal efficiency. Figure 4 is a photograph of the model showing the 5000-hp mechanical drive unit with regenerator. The addition of the regenerator increases the efficiency approximately to 24 per cent or an improvement in the order of 20 per cent above the simple open cycle type. This type unit has been designed specifically as a mechanical drive for such service as driving centrifugal compressors in gas pipeline pumping service.

Four such units are under construction, the first one is currently in process of erection for shop tests.

COMPOUND OPEN CYCLE WITH INTERCOOLER AND REGENERATOR

The third type plant developed is the compound open cycles with intercooler and regenerator.

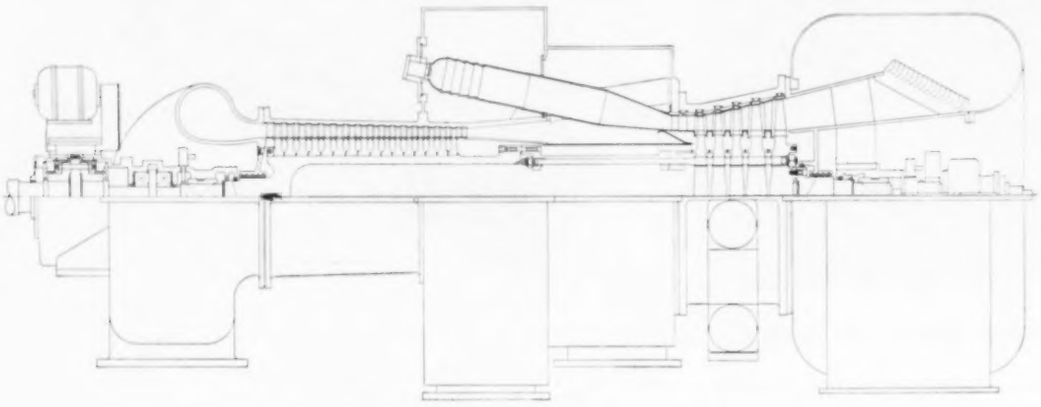


Figure 6 — Cross section through high pressure unit of 15,000-kw plant.

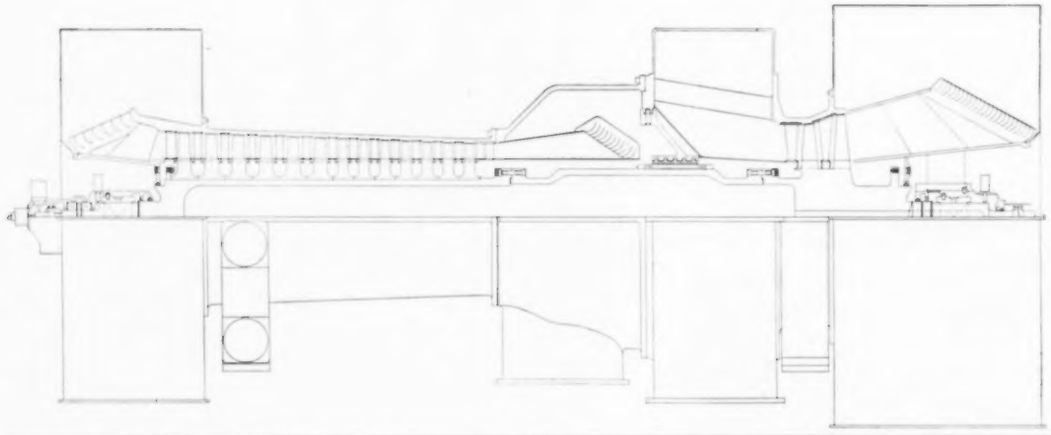


Figure 7 — Cross section through low pressure unit of 15,000-kw plant.

Figure 5 is a model of the 15,000-kw unit now in process of manufacture. This unit employs both intercooling and regeneration, and is designed for an efficiency of 27 per cent. This efficiency is comparable with the very best steam plants of this capacity. The cooling water requirements are about one-third that

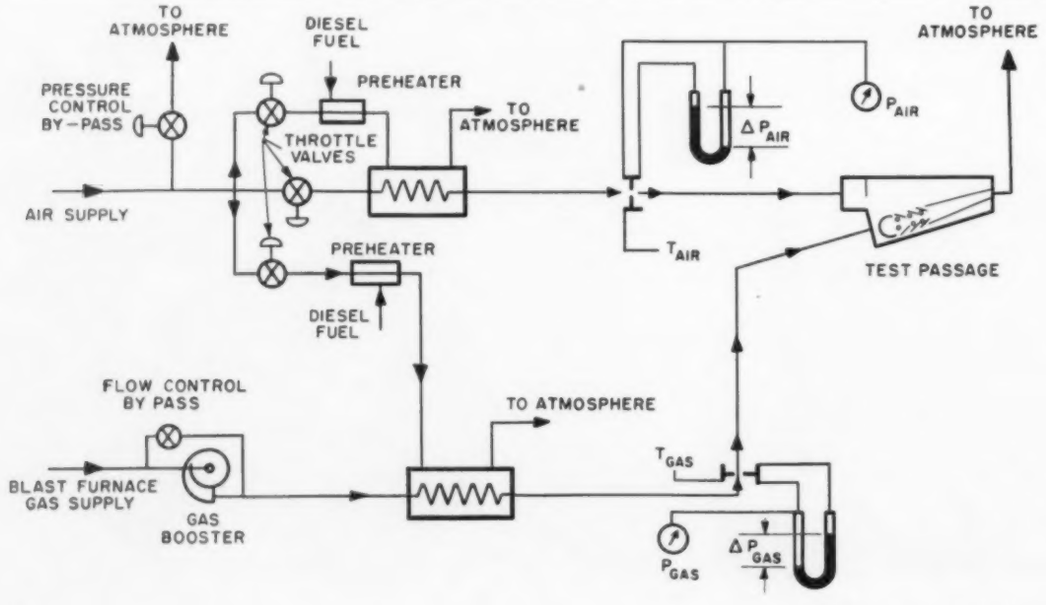


Figure 8 — Line diagram shows test installation of unit set up at the Carrie Furnaces to experiment with blast furnace gas.

of the steam plant. Figure 6 shows the cross section of the high pressure unit, Figure 7 is the cross section of the low pressure unit of this power plant.

BLAST FURNACE GAS COMBUSTION DEVELOPMENT

The gas turbine power plants developed to date have all been for liquid fuel or natural gas firing. To establish whether a suitable high heat release combustor using blast furnace gas fuel could be developed, a joint program was undertaken between the U. S. Steel Corp. and our company.

A low pressure combustion test rig was erected at the U. S. Steel Corp.'s Carrie Furnace at the Homestead District Works. Figure 8 shows the line diagram of this test installation. The combustor used in the test passage was taken from our 5000-kw gas turbine unit. The passage is arranged to accurately control the temperature of the incoming air and blast furnace gas over a very wide range.

Figure 9 shows a section through the combustion test passage in which the air and fuel gas are mixed and burned. Pressure and temperature measuring stations throughout the section are indicated.

The results of the combustion tests have shown that blast furnace gas can be successfully burned in our high heat release gas turbine combustion chambers with high efficiency. The flame stability, ignition characteristics, and fuel nozzle details have been established. With this test information we are now in a position to design the combustor, nozzle, and ignition details for our gas turbines to use blast furnace gas fuel.

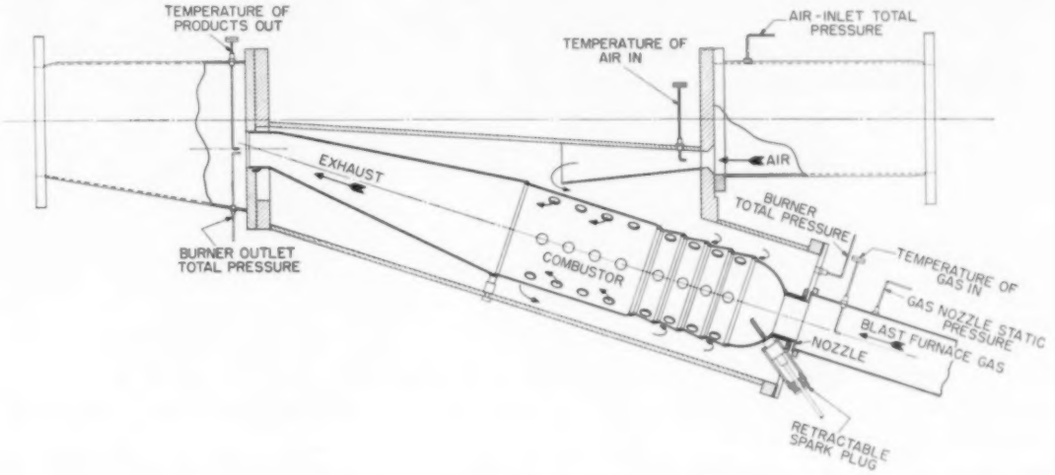


Figure 9 — Section through combustion test passage shows how air and fuel gas are mixed and burned.

GAS TURBINES USING BLAST FURNACE GAS FUEL

Gas turbine power plants can be made suitable for use with blast furnace gas fuel by modification of the combustors, addition of blast furnace gas compressors, and the necessary adjustment of aerodynamic flow paths. This latter is necessary because the large volume of inerts in the blast furnace gas fuel and the fuel flow becomes approximately twenty per cent of the total flow through the gas turbine.

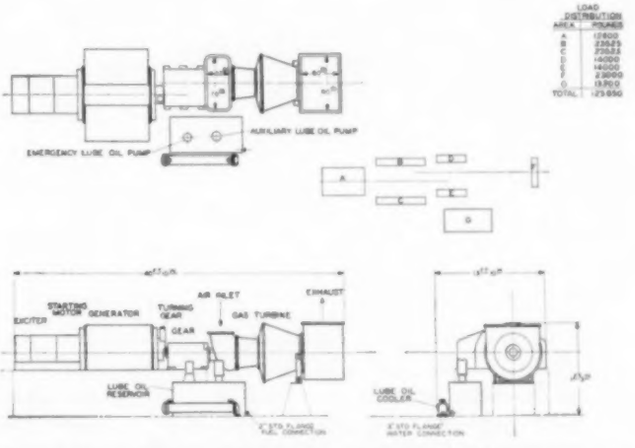
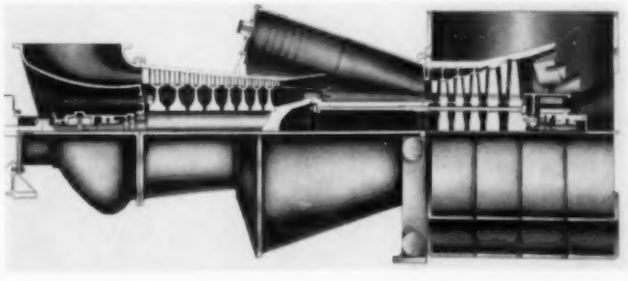


Figure 11 — Section shows operation of 4500-kw gas turbine power plant.

Figure 10 — Longitudinal cross section shows 4500-kw gas turbine generator unit which uses blast furnace gas for fuel.



4500-KW GAS TURBINE POWER PLANT FOR ELECTRIC POWER GENERATION

The longitudinal cross section of the 4500-kw gas turbine generator unit using blast furnace gas fuel is shown on Figure 10. Air is taken in by the axial flow compressor and compressed. Blast furnace gas, which has been compressed by centrifugal compressors, is admitted and burned in the combustion chamber to increase the gas temperature to approximately 1300 F. The hot gas expands through the gas turbine which converts the heat energy into mechanical energy to drive the axial flow air compressor, centrifugal blast furnace gas compressors and also provide useful power

at the output shaft. On leaving the gas turbine, the exhaust gases pass through a diffuser and exhaust duct to atmosphere.

The outline of the 4500-kw simple open cycle, gas turbine power plant for electric power generation is shown on Figure 11.

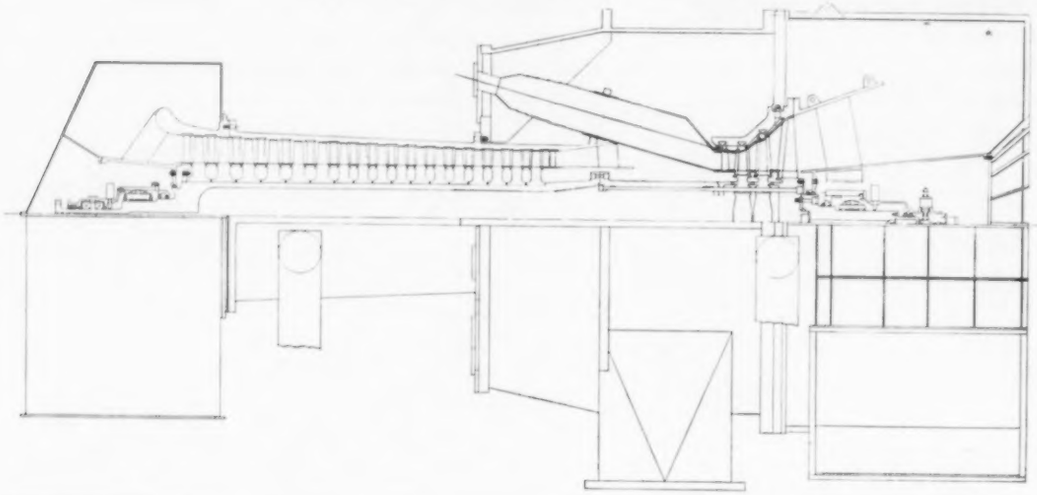


Figure 12—Longitudinal cross section shows gas turbine plant for air extraction.

125,000-CFM AIR EXTRACTION GAS TURBINE POWER PLANT

We have designed a gas turbine plant for air extraction with a continuous rating of 125,000 cfm for burning blast furnace gas fuel. The longitudinal cross section is shown on Figure 12. Atmospheric air is taken in by the axial flow compressor and compressed to a pressure of approximately 3½ atmospheres. At the discharge of the compressor, an extraction opening is provided to bleed 125,000 cfm of air for blast furnace gas blowing. Blast furnace gas fuel is mixed with the remainder of the air burned in the combustors and then expanded to the gas turbine.

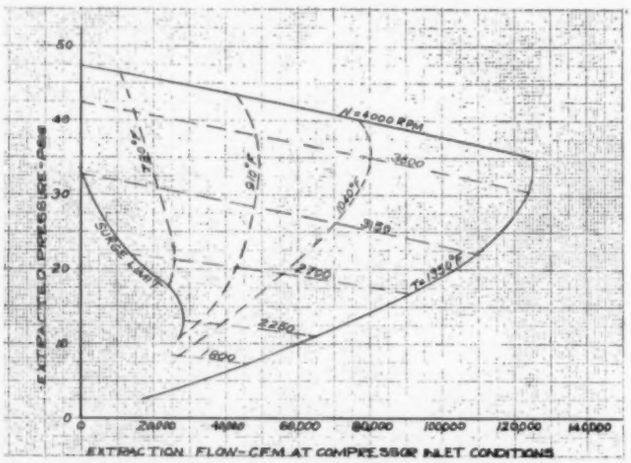


Figure 13 — Curve shows performance of simple open cycle gas turbine unit burning blast furnace gas. Compressor inlet design conditions are 80 F and 1000 ft altitude or less. Unit is rated at 25,000-cfm air extraction.

Figure 13 shows the air extraction performance for this unit. The outline of the complete gas turbine extraction power plant is shown on Figure 14. This shows that the overall operation requirements for this complete plant are 47 feet long, 15½ feet wide, and a maximum of 22 feet high. The compactness of the power plant reduces the building and foundation requirements to an absolute minimum.

DISCUSSION

PRESENTED BY

J. H. FRANZ, Superintendent Operating Maintenance, United States Steel Corp., Braddock, Pa.

T. J. PUTZ, Manager, Gas Turbine Engineering, Westinghouse Electric Corp., Philadelphia, Pa.

JOHN F. KOSTELAC, Assistant Electrical Superintendent, Crucible Steel Co. of America, Midland, Pa.

J. H. STRICKLER, Commercial Vice President, Elliott Co., Pittsburgh, Pa.

JULIUS GRAF, Chief Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

JOHN A. SUCCOP, Chief Metallurgical Engineer, Heppenstall Co., Pittsburgh, Pa.

CHARLES ALLEN, District Manager, Riley Stoker Corp., Pittsburgh, Pa.

D. M. SEELEY, General Facilities Engineer, United States Steel Corp., Pittsburgh, Pa.

HERB RYERSON, District Manager, Cardox Corp., Pittsburgh, Pa.

F. R. PULLEN, Fuel Engineer, Bethlehem Steel Co., Johnstown, Pa.

P. M. MORETON, Steel Co. of Wales, England

James H. Franz: Has anybody ordered one of these units for blower service?

T. J. Putz: To my knowledge, there are no gas turbines ordered for blower service or for use with blast furnace gas in this country, at the present time.

James H. Franz: Are there any European installations?

T. J. Putz: I know of two European installations, one in Spain and one in Germany. There may be others.

James H. Franz: Are they used with blast furnace gas?

T. J. Putz: Yes, they are arranged both for power absorption, and air extraction, enabling one to either bleed air or generate power.

James H. Franz: Some companies have done quite a bit of development on gas turbines, particularly for locomotive use, and for power. You mentioned that you have a unit in a locomotive. Is that running on the road in service?

T. J. Putz: Our unit has just completed 52,000 miles of revenue road operation. From the experience gained, we believe we can now design and build a gas turbine locomotive suitable for the American railroads.

Our gas turbine locomotive was built as an experimental unit. It has been operated on six of the major railroads of this country in revenue service. In the Eastern area, it operated on the Pennsylvania Railroad hauling 29 baggage cars on the passenger schedules between Harrisburg and Altoona.

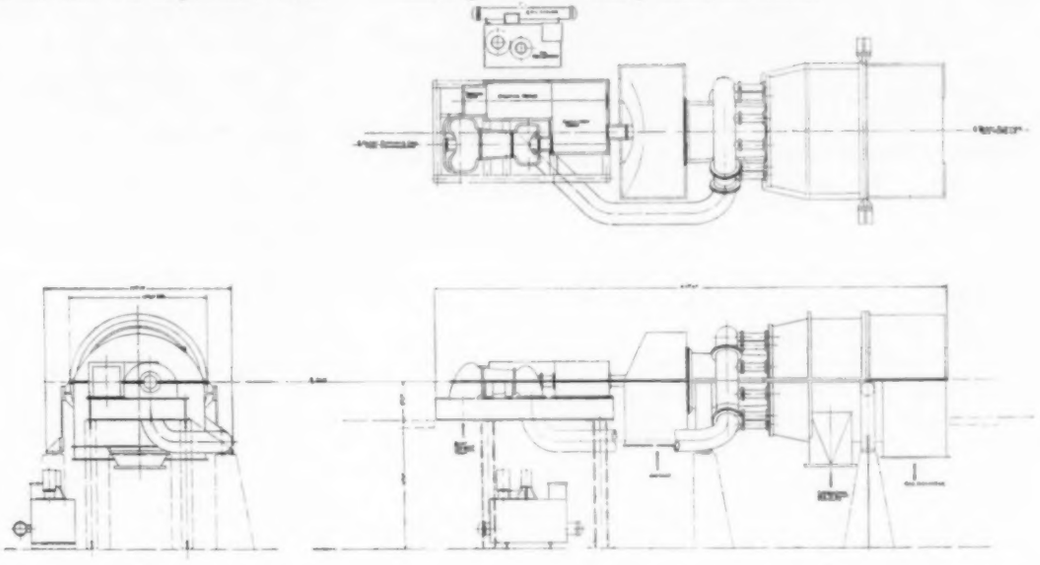


Figure 14 — Outline shows that plant requires an area 47 ft long, 50½ ft wide, and 22 ft high.

John F. Kostelac: What do you mean by quick starting time? What is the starting time on a 5,000-kw machine?

T. J. Putz: That unit can be started from cold in five minutes, and full load applied in another five minutes. The starting cycle, semi-automatic, is timed for between three or three and a half minutes. From that point on, you can apply the load as fast as you can take it on the system. In locomotive service full load is applied in less than one minute.

John F. Kostelac: How clean was the blast furnace gas?

T. J. Putz: The gas was taken directly from the electric precipitator, which supplies the gas to internal combustion engines. We used that just because it was available. We are now in the process of finding out how dirty we can handle the gas and still have no difficulty.

J. H. Strickler: I believe you mentioned your compressor was an eight-stage compressor, is that correct?

T. J. Putz: Each unit has a different number of stages.

J. H. Strickler: Was that an axial or centrifugal unit?

T. J. Putz: On the gas turbine end, we always use the axial type.

J. H. Strickler: The average blast furnace blower unit today is purchased for about 100,000 cfm of air at 30 psig air discharge. If you used your axial flow design, as part of a blast furnace blower unit, would you not have trouble due to the inherent instability of an axial compressor at capacities less than the design capacity?

T. J. Putz: The performance curve I showed gives the actual range of pressure and flow that can be covered by the axial flow compressor. That is variable speed. In certain regions you control the flow and pressure either by throttling or bypass.

J. H. Strickler: Do you bleed your axial compressor, depending on the load?

T. J. Putz: Yes, There is a range where you can adjust the turbine speed and the turbine inlet pressure. Beyond that range you either throttle or by-pass.

J. H. Strickler: Is it not true that a centrifugal unit has a greater stability than an axial?

T. J. Putz: That is correct.

James H. Franz: Are these European units big enough for one blast furnace, as far as air bleed requirements?

T. J. Putz: You are thinking in terms of 100,000 cfm?

James H. Franz: Yes.

T. J. Putz: I think those units rate about 50,000 cfm.

Julius Graf: As I recall the German machine which I saw in a plant near Dusseldorf, it had the capacity to blow one furnace. You must remember that the furnaces in Germany are normally of smaller capacity. This unit was not in operation when I saw it, but I was told it had the capacity to take care of one of the larger furnaces at the Dusseldorf plant. That is answering Mr. Franz's question about the capacity of this machine.

John Succop: We ordinarily think of the gas turbine as being quite similar in principle to the jet engine that is used to power airplanes, and I am wondering what the difference is between the use of high temperature fuel that is used in the jet engine compared to the blast furnace gas fuel, which contains about 500 Btu when compressed, with regard to the maximum temperature that would be developed on the bucket blades and on the rotor itself?

T. J. Putz: Our industrial machines are designed for maximum metal temperature of around 1300 F. This

metal temperature would be the same regardless of the type of fuel used. The type of fuel figures prominently in the selection of materials only when we get into corrosion problems, which is the case with some residual oils.

John Succop: Could I ask, what metals are used in the industrial turbine?

T. J. Putz: The metals used for blading and rotors are the austenitic type steels, 18-8, 25-20, 19-9 DL, the high nickel-chrome alloys, and nickel-cobalt alloys.

John Succop: What is used for the rotors?

T. J. Putz: Our rotors are made of the 19-9 DL.

John Succop: Do you use discaloy in rotors since it is your development?

T. J. Putz: We are actually working on such rotors but we are not prepared to offer them on our industrial units at the present time.

You see, the problems we have in using some of these better materials is procuring them in the sizes that we require for these industrial gas turbines. They are quite a bit bigger than the jet forgings because we run our industrial units at lower stresses.

Charles Allen: How does your price compare with boilers?

T. J. Putz: I do not know.

Charles Allen: What is the maximum size you plan on building these units in in the next four or five years?

T. J. Putz: The maximum size we contemplate building is our 15,000-kw size. That is the size we are stuck with for a while until we get more operating experience. You see, to develop that one, the turbine produces 45,000-kw while the compressor absorbs 30,000-kw. We find if we cannot be competitive with you boiler people economically when you put all the equipment in, we do not have too much chance selling them. So that is where we have to set our price. Our price is a competitive price. You did not ask us what the cost was.

D. M. Seeley: I am interested in the gas turbine locomotive, the type of fuel it used, and if it used any alternative fuels, and something about the drive. Was it a generator and motor type, like that employed in the diesel locomotive?

T. J. Putz: In our locomotive we had two-unit power plant 2000-hp per unit. Each gas turbine unit drove two 1000-hp generators, and each generator drove two motors, so the complete locomotive had four generators and eight motors. The electric drive was the conventional diesel type, that is, d-c with variable voltage.

The fuels ranged from distillate oils to the very heaviest residual oil. The major operation in the last year was on residual oils. Most of it was with low ash-low vanadium fuel as received without treatment. The fuel would be purchased in batches sufficiently large to cover all operation on each railroad. In this way we would know the exact composition of the fuel we were using for the entire duration of the run on that road.

D. M. Seeley: Have you tried pulverized coal?

T. J. Putz: We have not tried pulverized coal? The Bituminous Coal Research group, are doing work at Dunkirk on pulverized coal. Economically pulverized coal is taking a back seat because in many sections of the country you can buy oil cheaper than you can buy pulverized coal, so that there is very little incentive to try to burn coal.

Herb Ryerson: What kind of problems are you running into on lubrication in these units, and what pressures do you have to carry on the lubrication end of it?

T. J. Putz: As far as lubrication is concerned, we have really no problem there that is very much different than the lubrication problem with a steam turbine. We use ordinary turbine oil, and a pressure lubrication system. Our pressures to the bearings are in the order of ten psi.

On the first unit we built, most of our lubricating oil troubles were associated with bearings buried in the hot gas stream where the leakage of hot gases at 1300 F gave trouble. On our larger units, we have eliminated buried bearings and use external end bearings.

Herb Ryerson: You still use about ten psi pressure on those?

T. J. Putz: Yes, about ten psi pressure. The bearing design is similar to steam turbine bearings.

On the very small units, we use pad type journal bearings for stability reasons.

Herb Ryerson: I had a point to ask there. In the steam turbine, if your oil gets away from you and hits a hot pipe you have a fire. What happens if you spring a leak in one of your lines? Are there hot surfaces this oil can spray on?

T. J. Putz: We have it all insulated, and again, on our latest design we make it a point to keep all the really hot surfaces enclosed in a second case. On the 5,000-kw unit no surface runs at more than about 750 F. However, that is high enough to start a fire if you did not have it insulated, so you have still the same problem of insulating casings and pipes and keeping the oil away from those places as in steam turbines.

Julius Graf: I think this is a subject that all steel mill engineers and operators are keenly interested in. Any of you who travel the Ohio River Boulevard from Pittsburgh down to Rochester and look across the river in the evening and see the bleeders of our company burning good valuable fuel, which is going to waste, he must know that we are interested. We have been thinking about this problem for a long time. Particularly since I returned from Germany in 1946, I have been an advocate of it. I am glad to see that finally our big electrical people and our big turbine people are getting interested in the subject. And we are cooperating with one company, as a lot of you know, in making tests similar to what Mr. Putz has outlined at the U. S. Steel. We are all interested in it.

F. R. Pullen: A blast furnace is subject to fluctuations in its operation which makes an alternate source of fuel necessary in order to provide firm power. Can these turbines, if designed for blast furnace gas, be arranged for an alternate fuel?

T. J. Putz: The gas turbines can be arranged to use an alternate fuel such as natural gas or fuel oil by providing the necessary valving and alternate fuel nozzles.

P. M. Moreton: Is it anticipated that the air compressor will have to have filtering to the extent of electrostatic filtering, or just oil filtering?

T. J. Putz: It is our feeling that electrostatic filtering will not be required on compressors. On the railroad we used a coarse mesh screen on the inlet, to catch the birds and the big rocks. Oil washed filters should be entirely adequate.

A MODERN AUTOMATIC FUEL SHUT-OFF SYSTEM FOR SOAKING PITS

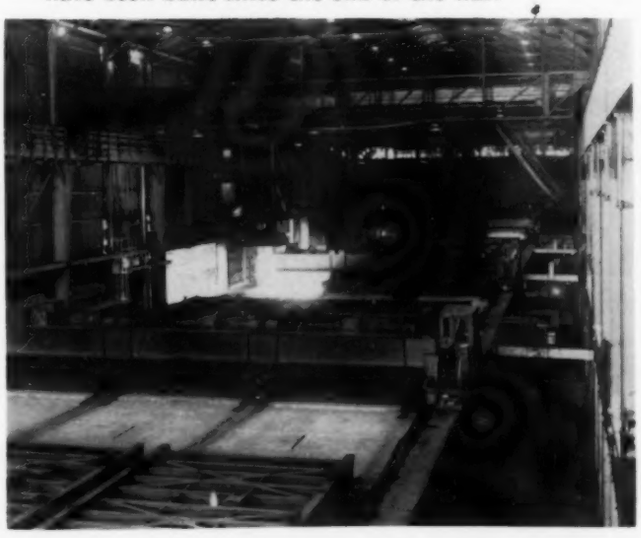
By A. L. LANCASTER
Chief of Electrical Design
Amsler Morton Corp.
Pittsburgh, Pa.

. . . . position of furnace covers or doors controls firing conditions in the furnace pits . . . .

▲ THE successful operation of ingot soaking pit furnaces is an important factor in the overall picture of steel production. It is essential that the soaking pits be capable of supplying the rolling tables with ingots that are completely "soaked-out"; i.e., with the internal temperature of the ingot the same as the surface temperature. It is further essential that the temperature variation between the individual ingots, when delivered to the rolling table, be held to a minimum.

As a general background for the subject which we are going to discuss, Figure 1 shows the layout of a recent soaking pit installation. The ingots are delivered to these soaking pits from the "incoming" ingot tracks, which are located along the far side of the installation. The ingots are placed in the pits by the overhead crane, soaked, and then delivered to the rolling table by an ingot buggy running on the tracks shown in the foreground.

Figure 1 — A number of new soaking pit installations have been built since the end of the war.



During the period that the ingots are in the soaking pit, the temperature of the pit and the firing conditions are controlled by any one of several well known systems. Figure 2, illustrates diagrammatically a typical method of controlling the firing conditions of the soaking pits during the heating and soaking periods. (This, incidentally, is known as a "two way, top-fired" soaking pit. A one way, top-fired and a bottom-fired pit will be illustrated later).

With the control system shown, the desired temperature is set at the temperature control instrument. The pit temperature is measured by the thermocouple in the pit wall. The temperature controller operates a valve drive unit, which in turn operates a valve in the fuel line. Thus, when the thermocouple signals the controller that the pit temperature is below the desired temperature, the temperature controller translates this information to an impulse, which causes the valve drive unit to open the valve in the fuel line, and increase the flow of fuel to the pit.

When the ingots reach the desired temperature, the thermocouple transmits this information to the temperature controller, which in turn causes the valve in the fuel line to be driven partially closed. With the ingots at the desired temperature, only a small amount of fuel enters the pit. This allows the ingots to "soak out," and also overcomes the normal stack and radiation losses from the pit.

Through the use of a combustion regulator a predetermined ratio between the fuel and the combustion air is automatically maintained, to produce a desired atmosphere within the pit. The atmosphere used is dependent on the type or condition of the steel being heated, as well as the end use of the steel. This atmosphere may be either oxidizing, neutral, or reducing.

The flow of fuel and combustion air is measured by means of two orifice plates, one mounted in the fuel line, and the other mounted in the combustion air duct. Through impulse lines, the differential pressure created across these orifice plates is applied to the fuel-air ratio regulator. The fuel-flow differential pressure is applied to one side of the regulator, and the air-flow differential pressure is applied to the other side of the regulator.

When the flow of fuel and air to the pit is of the proper pre-determined ratio, the regulator is said to be "in balance." With a change in fuel flow, the regulator will become unbalanced by the change in differential pressure across the fuel flow measuring orifice plate.

The unbalanced regulator will then send out a signal to a drive unit which will reposition the air flow control valve to restore the air flow to the proper ratio with the fuel flow.

With the ratio of the air to the fuel corrected, the change in differential pressure across the air orifice plates will restore the regulator to the neutral or balanced position. This will block the travel of the air flow control valve until another change in the fuel flow occurs.

While discussing the combustion air system, it will be of interest to the combustion engineers present to notice the stub tubes which are shown at the top of the recuperator chamber. The addition of these improved stub tubes to the setting, plus a sand seal which functions efficiently throughout the life of the recuperator, still further extends the service life of this unit.

Another factor involved for good firing conditions is the control of the pressure within the pit. Too great a negative pressure will cause air infiltration, which will not only reduce the efficiency of the pit, but might also be damaging to the steel being heated.

Too great a positive pressure will not only increase the erosion of the pit refractory, but will also reduce the efficiency of the pit by the heat lost because of gas exfiltration.

Therefore, a furnace pressure regulator is provided to permit operating the pit at a pressure that will best suit individual conditions.

The desired pit pressure is set at the pressure control regulator, which is located on the control panel board.

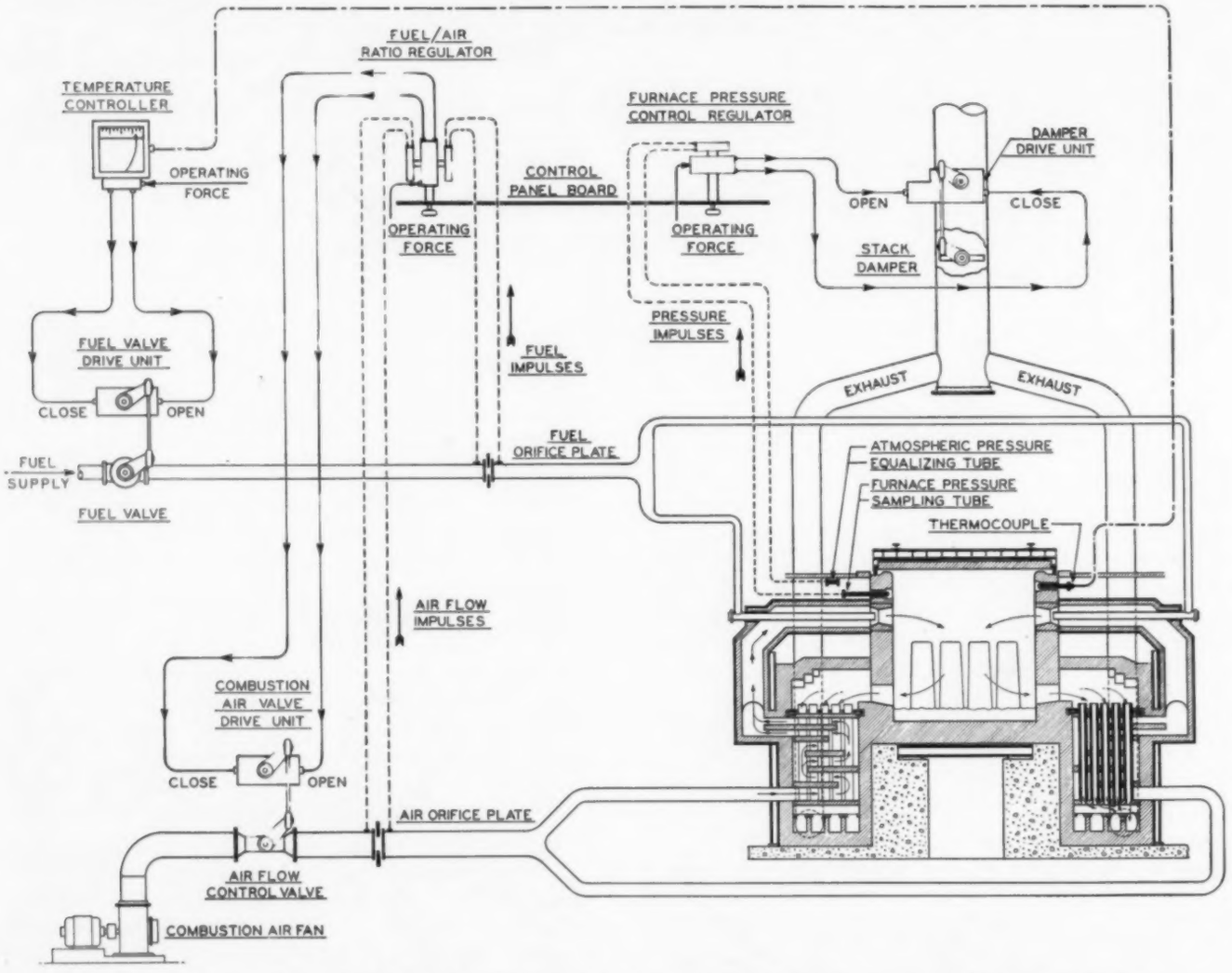


Figure 2 — Diagram shows method of controlling firing conditions of a two-way top fired ingot soaking pit.

The pit pressure is sampled by means of a tube extending through the pit wall to the inside of the pit. The pressure inside of the pit is balanced against the normal atmospheric pressure, which is sampled by a second tube located immediately outside of the pit wall.

The difference in pressures, as sampled by these two tubes, is transferred by impulses to the pressure controller. The pressure controller then transfers an impulse to the stack damper drive unit, which in turn positions a damper in the stack to provide the desired pit pressure.

The foregoing describes a typical combustion control scheme for a soaking pit. The method of conveying the control impulses and the type of force used to operate the valve drive units has been shown diagrammatically.

Conventional systems are available where the impulses can be transferred, and the valves operated hydraulically, pneumatically or electrically. Individual local conditions govern the selection of the type of equipment best suited for any given installation.

To complete the background information, it may be stated that several well proven systems are available to automatically control the firing conditions throughout the heating and soaking periods, when the covers are in place on the pits.

We now come to the main body of this discussion.

It is equally as important that the pit firing conditions be as carefully regulated during the drawing period, when the pit covers are repeatedly removed and replaced, as it is to have close control of the firing conditions during the heating and soaking cycles.

Inasmuch as the automatic control circuits previously described will be upset when a cover is removed from the pit, a different set of problems concerning the control of the firing conditions arise when the ingots are ready to be drawn and sent to the rolling table.

With the system that we are about to describe, the control of the supply of fuel and air, as well as the operation of the stack damper, is determined by the position of the pit cover. With the pit cover in place on the pit, the furnace regulators control the supply of fuel and air and maintain a predetermined temperature and pressure in accordance with the desired firing cycle. When a pit cover is removed, the object is to interrupt the firing cycle and to retain as much heat as possible within the pit during the time that the cover is removed.

When the pit cover is raised for removal, it is advisable to have the following functions take place automatically.

First, the fuel should be shut off. The main advantage of shutting off the fuel is economy. If the fuel is not shut off when a pit cover is removed, most of the heat from the fuel will pass directly up out of the pit, and be lost.

Further, shutting off the fuel provides the overhead crane operator with a clearer view of the ingots, obviously better working conditions, and avoids subjecting the cover refractories and seals to unnecessary flame impingement.

Second, the combustion air should be shut off. Without fuel in the pit, there is no need to have combustion air.

Third, the stack damper should be closed. This is important to prevent air infiltration into the pit, which would lead to a temperature drop in the ingots.

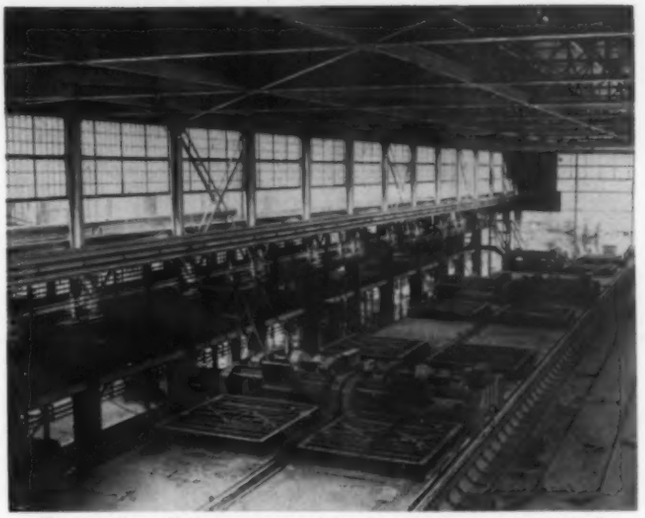


Figure 3 — Carriages on this pit use remote control.

Inasmuch as the position of the pit cover is the governing factor of the firing conditions during the drawing period, it is logical to use the equipment which handles the pit covers to initiate the impulses which control the firing conditions.

On a modern soaking pit installation, the covers for several rows of pits are handled by a common cover carriage. On an extensive installation, consisting of many rows, of soaking pits it is advisable to have more than one cover carriage.

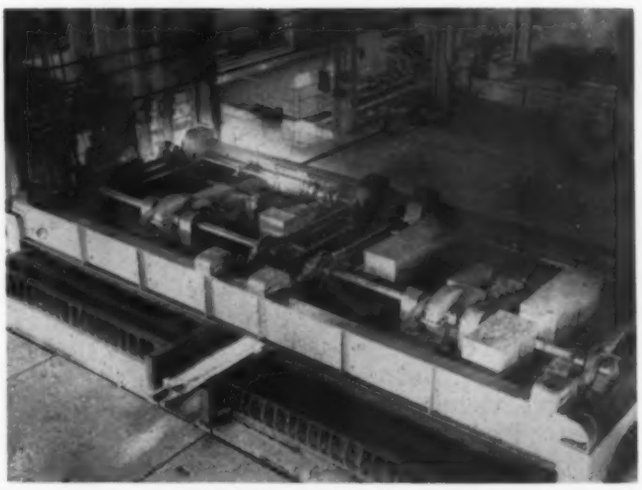
The cover carriages fall into two distinct classes; namely, "cab-operated" and "remotely-controlled" carriages.

A typical soaking pit installation using remote control carriages is shown on Figure 3.

As the name implies, a "remotely-controlled" carriage is operated from a stationary control pulpit which is not an integral part of the carriage. The cover carriages shown in this figure are operated from the master switches which can be seen on the pulpit on the walkway in the background of the photo.

On a "cab-operated" cover carriage, the operator rides with the carriage. A typical cab operated carriage is shown on Figure 4. This type of carriage is operated

Figure 4 — Shown here is a typical cab operated cover carriage.



from control master switches located in the carriage control cab.

Regardless of the type of cover carriage used, the position of the pit cover governs the firing conditions in the pit. However, the impulses which initiate the changes in the firing conditions are obtained in two separate manners, which do depend on the type of cover carriage operation.

When a cab-operated cover carriage is used, it is obvious that the operator and all the mechanism required to raise the pit covers will move wtih the carriage from row to row.

The regulators and valves which control the firing conditions for the individual pits are stationary. Therefore it is necessary to provide some method of transferring an impulse from the mobile carriage to operate each individual pit's stationary fuel control equipment.

A typical method of transferring the necessary control impulses from the cover carriage to the stationary equipment is to install an assembly of short conductor rails at the centerline of each row of soaking pits. The number of rails in this assembly is governed by the number of pits in each row for any given installation. One rail is required for each pit in the row, as well as additional rail which is common to all of the pits. In other words, if there are two soaking pits in each row, an assembly of three short rails is required. Likewise, if there are three pits in each row, an assembly of four short rails is required.

An assembly of pick up shoes is located on the cover carriage. These shoes are so positioned, that, when a carriage is centered over a row of pits, one shoe is in contact with each of the stationary short rails. Thus it is possible, in this position, to complete one or more electrical circuits from the cover carriage, through the pick up shoes and short rails, to the stationary fuel control units.

Figure 5 gives a close-up view of the pick up shoes on the cover carriage engaged with the stationary short conductor rails. You will note that there are four individual short rails shown in this assembly.

The cover carriage has a plurality of hoist motors and hoisting mechanisms. The number of hoist mechanisms on the carriage corresponds to the number of pits in each row. Each hoist mechanism is controlled by an individual hoist master switch.

To remove a cover from a pit, the carriage operator traverses the carriage to the centerline of the row of pits to be serviced. When the carriage is at this location, the hoisting mechanisms on the carriage are in position to lift a pit cover, and the fuel pick up shoes are in contact with the fuel assembly rails.

By virtue of a safety interlock, only one cover may be raised at a time.

To raise a pit cover, the carriage operator displaces the proper hoist master switch to the "Raise" position, which causes a hoisting mechanism to raise the cover from the pit from which the ingots are to be withdrawn.

In view of the fact that the cover carriage can raise any one of the covers in a row of soaking pits, and that the heating control of each pit is independent, it is necessary to have separate equipment on the cover carriage to control the fuel circuits for the individual pits.

The shaft of each hoist mechanism is provided with

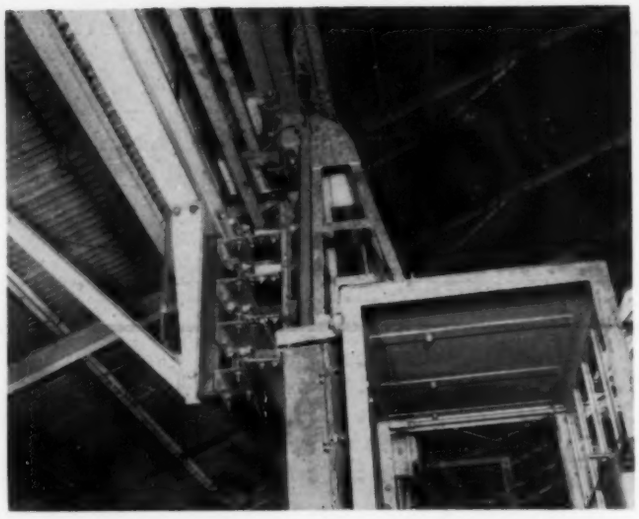


Figure 5 — Pickup shoes engage the stationary short conductor rails.

a rotating cam-type limit switch. A contact in this limit switch is connected by wires to the pick up shoes on the carriage which are in contact with the stationary fuel control rails. Thus an electrical circuit can be completed from the hoisting mechanism on the cover carriage to the stationary fuel control valves.

Figure 6 shows diagrammatically the functions of the equipment which controls the firing conditions when the cover is removed from the pit. A "one-way, top fired" soaking pit is shown here to illustrate this system. However, the system will operate with equal efficiency on either a "top-fired" or "bottom-fired" pit. The location of the burner ports have no bearing on the functioning of the fuel shut-off system.

As the cover is raising, a contact in the rotating cam limit switch is closed. This completes a circuit from the rotating cam limit switch, through the short rails, to the stationary ratchet-type relay. This relay functions to deenergize a control timer.

A quick-acting, air operated shut-off valve is located in the fuel line. This valve is held open by compressed air, and closes automatically upon air pressure failure. A control solenoid valve is mounted in the line that supplies the compressed air which holds the shut-off valve open.

When the timer is deenergized by the ratchet relay, the fuel control solenoid is likewise deenergized. This releases the air loading from the air motor of the quick-acting shut-off valve, thereby causing the valve to close. With the valve closed, the flow of fuel to the pit is halted.

With the fuel flow to the pit now stopped, the next factor to be considered is the combustion air.

As previously mentioned, the amount of combustion air which enters the pit is controlled by the amount of fuel which enters the pit. Therefore when the fuel flow falls to zero, the fuel-air ratio system causes the combustion air flow to stop also.

Inasmuch as the fuel flow to the pit has stopped, the pressure in the pit will drop. The drop in the pit pressure causes the stack damper to be driven closed by the functioning of the furnace pressure control system.

The closing of the stack damper is a very important feature of this system. If the stack damper were not

closed, a large amount of air would be drawn into the pit through the pit opening, and be drawn out the stack. This would be very wasteful of the heat in the pit, and cause a drop in the temperature of the ingots remaining in the pit.

To summarize, the changes which have been caused in the firing conditions of the pit by the removal of the cover are as follows:

1. The fuel has been shut off.
2. The combustion air flow has stopped.
3. The stack damper has been closed.

Upon the completion of the withdrawing of an ingot from the pit by the overhead crane, the pit cover is again replaced by the cover carriage.

The replacing of the pit cover initiates the action which restores the normal firing conditions to the pit.

When the cover carriage returns to the centerline of the pit to replace the cover, the fuel system pick up system contact in the rotating cam limit switch is again closed. An electrical circuit is again completed, from the rotating cam limit switch, through the short rails, to energize the ratchet relay.

The ratchet relay acts as a control switch for the timer. When the ratchet relay is energized as the cover lowers, a contact in the ratchet relay closes, completing an electrical circuit to the timer, which starts the timer on its cycle.

The timer is a very important part of the fuel control system. It is the timer which controls the sequence and the timing of the functions which re-establish the normal pit firing conditions.

The timer has two contacts, which close in sequence. The second contact in the timer cannot close until several seconds after the first contact has closed.

As the timer starts on its cycle, it closes its first contact, which completes an electrical circuit to two sets

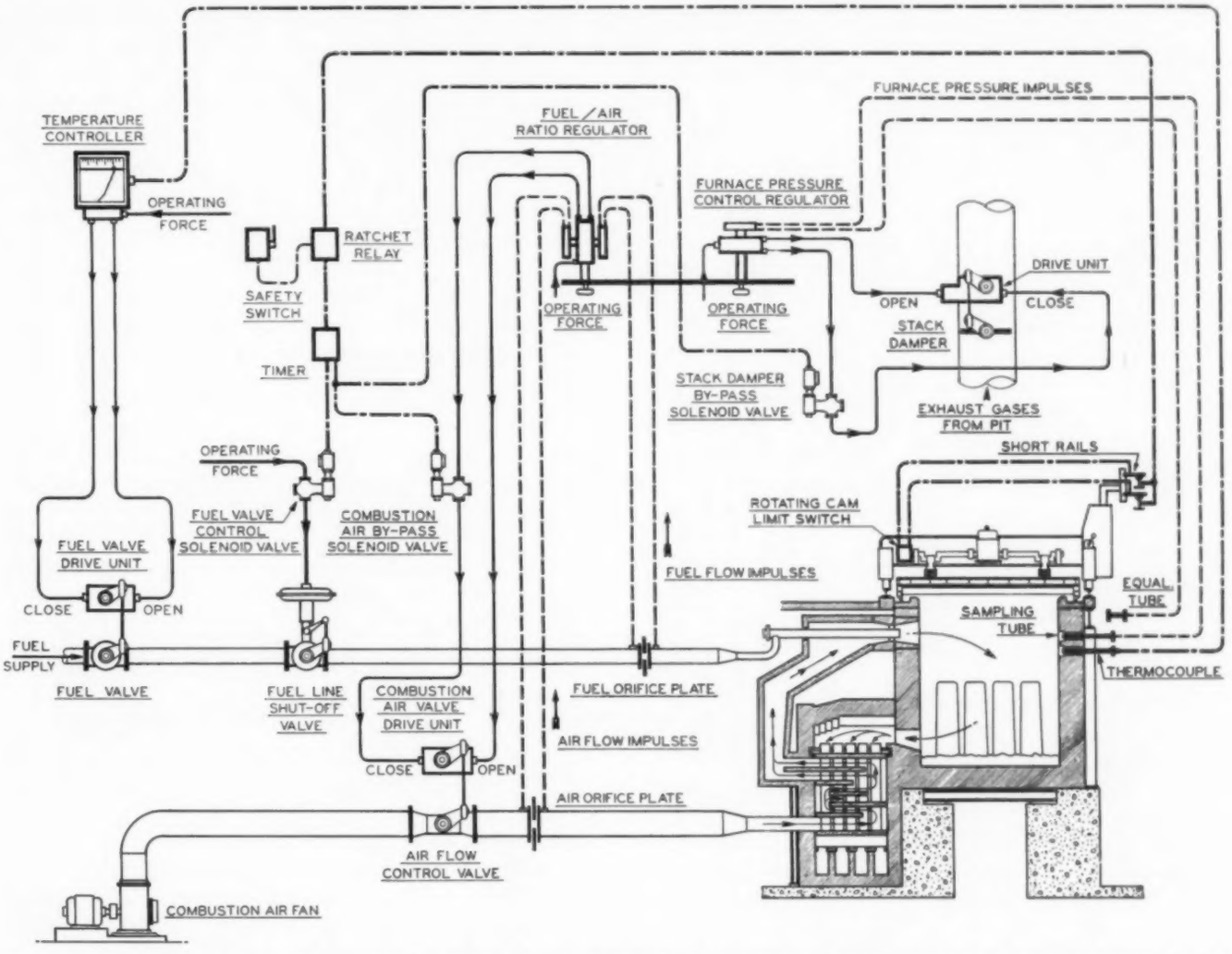


Figure 6 — Schematic shows the equipment which controls the firing conditions when the cover is removed from a cab operated pit.

shoes on the cover carriage again come in contact with the stationary short fuel system rails. It is again possible to complete an electrical circuit from the cover carriage to the stationary fuel control devices.

To replace the cover on the pit, the carriage operator displaces the proper master switch to the "lower" position.

As the cover is being lowered onto the pit, the fuel of solenoid valves. These solenoid valves are called the "Combustion Air Control System By-Pass Solenoid Valve" and the "Stack Damper Control System By-Pass Solenoid Valve." As the name implies, these solenoids act to by-pass the normal combustion air and stack damper controllers.

When the pit cover was removed from the pit, the furnace pressure control system acted to close the stack

damper. The stack damper solenoid now functions to drive the stack damper open.

This is accomplished by the stack damper by-pass solenoid valve taking precedence over the furnace pressure controller, and applying the operating force directly to the "opening" side of the stack damper control valve. This valve in turn drives the stack damper wide open.

At the same time that the "Stack Damper By-Pass Solenoid Valve" is energized, the "Combustion Air By-Pass Solenoid Valve" is also energized. The combustion air by-pass solenoid valve now by-passes the fuel-air ratio system, and sends the operating force directly to the "opening" side of the combustion air valve drive unit, which permits the supply of combustion air to return to the pit.

When the second contact in the timer is closed, the fuel shut-off solenoid valve is energized.

It will be remembered that the flow of fuel to the pit depends on the position of the fuel shut-off solenoid valve. When this valve is deenergized, the automatic temperature control system is blocked off, and the fuel cannot flow to the pit.

When this solenoid valve is now energized, the main shut-off valve in the fuel line is opened, and the fuel flow to the pit is restored under the control of the automatic temperature control system.

It is important to have the pit firing conditions restored in an orderly manner for the following reasons.

First, the stack damper must be held wide open. When the fuel is restored to the pit, the ignition of the fuel will momentarily cause an abnormal pressure in

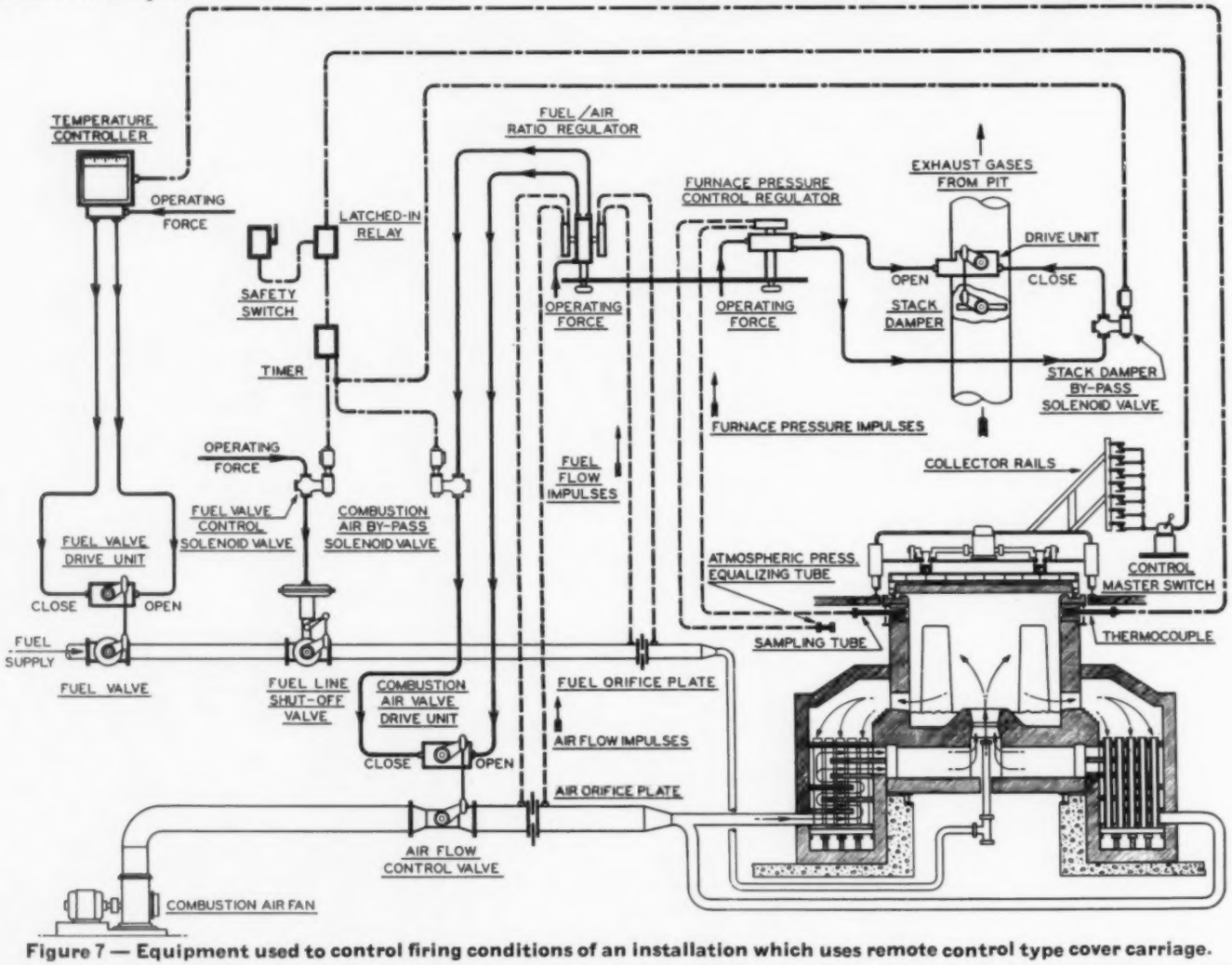


Figure 7 — Equipment used to control firing conditions of an installation which uses remote control type cover carriage.

At this point of the control cycle, we therefore have the stack damper being driven open, and the supply of combustion air is being restored to the pit. Up unto this point, no fuel has been allowed to enter the pit.

After a short adjustable period of time, which is typically about seven seconds, the timer opens its first contact and closes its second contact.

When the first contact in the timer is opened, the combustion air and the stack damper by-pass solenoid valves are deenergized, allowing the furnace pressure system and the fuel-air ratio systems to return to the preset automatic control.

the pit. With the stack damper wide open, this pressure is harmlessly channeled out of the pit and up the stack.

Second, a large volume of combustion air should be present in the pit before the fuel is introduced. In the event that the fuel flow was restored to the pit before sufficient air was present to support combustion, raw fuel would be concentrated in the pit and in the waste gas flues. This would lead to the danger of an explosion when sufficient air entered the pit to permit ignition of the fuel.

Under the controlled system, this danger is eliminated as the timer causes the combustion air to be re-

stored to the pit before the fuel flow is resumed. As there is a suitable amount of combustion air present, the fuel is immediately ignited as it enters the pit at the burner port.

The foregoing described the type of equipment used to control the pit firing conditions during the ingot drawing period, when a "cab-operated" cover carriage is used to handle the pit covers.

On an installation where a "remotely-controlled" cover carriage is used, similar control of the firing conditions is obtained. However, this control is obtained in a different manner when using a remote control cover carriage than it is when using a cab-operated carriage.

Figure 7 shows diagrammatically the equipment used to control the firing conditions for an installation using a remote control type cover carriage.

It will be remembered that the hoisting mechanisms on a cab-operated cover carriage are controlled by master switches located in the carriage cab. These master switches naturally move with the cover carriage.

A remote-control cover carriage is controlled from stationary master switches, located on a balcony near the centerline of each row of soaking pits. The master switches are connected electrically to the cover carriage, by sliding contacts or trolleys.

On a cab-operated cover carriage, it is necessary to transfer an electrical circuit from the mobile carriage, through the short fuel rail assembly, to the stationary fuel control equipment.

On a remote control carriage, advantage is taken of the fact that the control master switches for the cover carriage are stationary. The electrical circuits are thus run directly from the stationary master switches to the stationary fuel control equipment.

It is not necessary to transfer an impulse from the mobile cover carriage to stationary equipment. The necessity of an assembly of short fuel system rails is therefore not required when using a remotely-controlled cover carriage.

We will now see how the pit firing conditions are controlled during the ingot drawing period, when using a remotely-controlled cover carriage.

We will assume that the pit has been at a soaking temperature, and that the ingots are ready to be drawn. At this point of the heating cycle, the firing conditions are under the control of the conventional regulators.

To remove a cover from a pit, the carriage is traversed to the centerline of the row of pits to be serviced, by the use of the "traverse" master switch located on the stationary pulpit.

With a remotely controlled carriage, there are individual control master switches for each hoist mechanism on the carriage, similar to those described for the cab-operated carriage.

To raise a cover from a pit, the operator selects the proper hoist master switch, and displaces it to the "raise" position. This will energize a hoist motor on the cover carriage, which begins to lift a cover from the pit.

When the hoist master switch is in the "raise" position, an auxiliary contact in the switch is also closed which completes an electrical circuit to the release coil of a latched-in relay. This relay acts as the control switch for the fuel system timer, similar to the ratchet relay described for the cab-operated pit fuel system. When the latched-in relay is released, the timer is de-energized.

The sequence of control action following the de-energizing of the timer duplicates the fuel shut-off action previously described.

When the timer is de-energized, the fuel control solenoid valve is likewise de-energized, which causes the main valve in the fuel line to close.

The fuel flow to the pit is now halted. When the fuel flow falls to zero, the fuel-air ratioing system causes the combustion air flow to be halted also, through the normal functioning of the fuel-air ratio regulator.

With the cover raised and the fuel and air flows stopped, the pressure in the pit will drop. The automatic furnace pressure control system registers this information and the stack damper is driven closed, as previously described.

In summary, the fact that the pit cover has been raised, caused the timer to be de-energized, which in turn caused the fuel flow and the air flow to be cut off from the pit, and the stack damper to be driven closed.

Upon the completion of the withdrawing of an ingot by the overhead crane, the pit cover is again replaced by the cover carriage.

The cover carriage is traversed back to the centerline of the row of pits. The proper control master switch is displaced to the "lower" position, which causes the cover to start to lower onto the pit.

When the master switch is displaced to the "lower" position, a second auxiliary contact in the switch is closed, which completes an electrical circuit to the closing coil of the latched-in relay. The relay in turn then completes an electrical circuit to the timer, starting the timer on its cycle.

The timer acts to restore the normal firing conditions to the pit in the proper sequence, as previously described.

First, the stack damper solenoid valve is energized, which bypasses the furnace pressure controller, and drives the stack damper open.

Second, the combustion air solenoid valve is simultaneously energized, which by-passes the fuel- air ratio system, and restores the combustion air flow to the pit.

Third, after a seven second time delay, the furnace pressure system by-pass solenoid valve and the combustion air controller by-pass solenoid valve are de-energized, and the fuel shut-off solenoid valve is energized. This permits the furnace pressure controller and the fuel-air ratioing system to return to their normal control, and restores the flow of fuel to the pit.

It will be noted that the firing condition equipment which the timer controls is an exact duplicate for an installation using a remote-control cover carriage, as the equipment used with a cab-operated cover carriage. The only difference in the two systems being the method of initiating and transferring the impulses which start the timer on its cycle.

The fuel control system which we have shown has been well proven in service, and is in use today on hundreds of soaking pits. Only the basic parts of the system have been described.

In addition to those main parts of the system which

have been discussed, it is customary to install safety interlocks, which automatically shut off the fuel in case the combustion air supply is interrupted, or in case of electrical power failure. These safety features make it impossible to have any fuel in the pit, unless there is sufficient combustion air present.

A selector switch is also generally added to the control circuits. This switch is mounted on the control panel board, and makes it possible to operate the fuel system manually, as well as automatically.

Other accessories which may be added are indicating lights, which show when the pit is at a soaking temperature, or ready to be drawn. In case more than one type of fuel is used with the soaking pits, indicating lights can also be added to show which type of fuel is being used in the various pits.

This automatic fuel shut-off system, proven in many installations, not only in America but throughout the world, over a period of many years, is a step in the universally approved goal of eliminating human errors by making a very necessary operation fully automatic.

In conclusion, we would like to mention that a soaking pit application has been used to illustrate this fuel shut-off system, whereby the firing conditions of a furnace are controlled by the position of the furnace covers or doors. The system, however, can be adapted to any type of furnace where it is desirable to shut off the fuel whenever the furnace closure is opened.

DISCUSSION

PRESENTED BY

J. L. MILLER, Assistant Chief Combustion Engineer, Republic Steel Corp., Cleveland, Ohio

A. L. LANCASTER, Chief of Electrical Design, Amsler Morton Corp., Pittsburgh, Pa.

NATALE M. PUSATERI, Combustion Engineer, Amsler Morton Corp., Pittsburgh, Pa.

GEORGE R. HAMILTON, JR., General Supervisor, Fuel Engineers, Gary Works, United States Steel Corp., Gary, Ind.

HERMAN C. HENSCHEN, Combustion Engineer, Bethlehem Steel Co., Sparrows Point, Md.

J. Ledlie Miller: Does it make any difference how you draw the pit with that type of control? Would you draw it from the center, or either end? You show a two-way fired pit. I was wondering how that affected your thermocouples. Where are the thermocouples located for control?

A. L. Lancaster: If I caught the first question correctly, it was whether or not it made any difference (to the fuel shut-off system) if the pit was drawn from the center or either end.

The sequence of drawing, as well as the location of the thermocouples, does not affect the fuel shut-off system. As previously mentioned, these drawings are very diagrammatic, and the location of the equipment for any given installation will vary.

When the pit cover is removed, the fuel will be shut off, and the overhead crane will draw an ingot. The cover carriage operator then closes the pit, so the fuel is only shut off for a very few minutes. I might say that on a fast operation, when the overhead crane draws an ingot, the fuel is shut off less than one minute, so it does not matter from which end the pit is drawn. The purpose of the system is to maintain the fuel flow to the pit as much as possible during the drawing period, to retain as much heat as possible in the pit.

Herman C. Henschen: The intelligence that your cover is open on your cab-operated cover carriage pits is transmitted through rails. I would like to know if you have tried limit switches operated by the cover and how that service compares with the system you have proposed.

A. L. Lancaster: The next question is concerned with whether it is possible to operate a fuel shut-off system by placing a limit switch on the deck proper and operating it with a pit cover. That seems to be a logical method of operating a fuel shut-off system, and is something which we used in the past.

This system was tried, but several difficulties arose with the limit switch operation, and the method proved to be more successful in theory than in operation. There are a few installations where a deck limit switch is in successful operation today, but these installations are in the minority. The main difficulty is the fact that you are operating a small limit switch with a twenty-five or thirty ton pit cover, and, with the amount of heat around the limit switch location, it is a poor place for anybody to do maintenance work. Generally, the limit switch will fail.

The system which has been described can be called the answer to the problems which arose on these installations where a pit switch system proved to be inadequate.

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Coke and By-Products in 1952

. . . . data from the Mineral Market Reports M.M.S. No. 2186, July 1953; M.M.S. No. 2221, October 1953 and M.M.S. No. 2229, November 1953 . . . .

▲PRODUCTION of oven and beehive coke in the United States in 1952 as reported to the Bureau of Mines, United States Department of the Interior, decreased 14 per cent from the record established in 1951 and totaled 68,254,109 net tons. As coke production is geared closely to steel production, the lengthy strike in the iron and steel industry caused virtually all of the "furnace" oven- and beehive-coke plants to suspend operations during June and July. The close relationship between these two industries was clearly demonstrated by the similarity in operating rates in each industry in 1952. According to data published by the American Iron and Steel Institute, the rate of operations of iron blast furnaces in 1952 averaged 84.2 per cent of capacity as compared with 84.0 per cent for slot-type coke ovens reported to the Bureau of Mines. Beehive production was affected even more adversely than oven coke by the interruptions in blast-furnace operations in 1952, and production declined 40 per cent from the 1951 output. As a result, beehive-coke production which amounted to 9 per cent of the total output of oven and beehive coke in 1951 accounted for but 6 per cent in 1952.

Although production of coke dropped drastically in 1952, the banking of iron blast furnaces during the steel strike reduced coke requirements proportionately, and supplies of metallurgical coke were sufficient in general to meet essential needs. Extension of natural gas pipe lines, particularly in New York, reduced the requirements of coke for manufacturing water gas and resulted in the permanent retirement of two oven-coke plants in this state. These two plants with an annual coke capacity of about 800,000 net tons were the Brooklyn Union Gas Co.'s plant at Greenpoint and the Rochester plant of the Rochester Gas and Electric Corp. According to data supplied by all producing companies on the disposal of coke in 1952, 86 per cent was utilized by iron blast furnaces, 4 per cent by iron foundries, 4 per cent for manufacturing producer gas and water gas, 3 per cent for other miscellaneous industrial uses (nonferrous smelting, chemical processing, etc.), and 3 per cent for residential heating.

Expansion of coke capacity in the oven-coke segment of the industry was hampered by work stoppages in 1952. The silica brick supply improved during the year with the installation of additional brick-making facilities, but the steel strike curtailed the flow of essential steel and delayed until 1953 a large part of the new capacity that was expected in 1952. In spite of these difficulties, the coke industry experienced one of the greatest construction years in history. Coke producers reported that 947 new ovens with an annual coke capacity of 5,317,400 net tons were completed and 1,075 new ovens with a designed annual coke capacity of 5,983,600 net tons were under construction on December 31, 1952. All of the ovens completed in 1952 did not represent additional capacity as a large number were replacement of old ovens previously dismantled. Although 658 ovens having an annual coke capacity of 2,945,000 net tons were taken out of production, either for rebuilding or permanent retirement, the industry did achieve a net gain of 289 ovens during the year. At the end of 1952, there were 15,608 slot-type ovens in place with a potential annual coke capacity of 76,428,000 net tons. The total number of beehive ovens available at the end of the year totaled 17,551, with an annual coke capacity of 12,004,800 tons; but only 14,797 ovens with a capacity of 10,304,400 tons were reported to be in operable condition.

Production of the primary coal-chemical materials and derivatives were adversely affected by the interruption in oven operations in 1952. Output of each of the following dropped 12 per cent below the 1951 totals —crude tar, crude light oil, and coke-oven gas—and ammonia production (NH_3 content of sulfate and liquor fell 11 per cent. The reduction in supplies of crude tar and light oil naturally resulted in substantial decreases in production of the various derivatives. Production of benzol (excluding motor grade) at oven-coke plants decreased 10 per cent in 1952, toluol and xylol, 11 per cent; crude naphthalene, 19 per cent; creosote oil, 8 per cent; and crude chemical oil, 18 per cent from the 1951 figure. Although supplies of benzol, toluol, and naphthalene were scarce at the beginning of the year, supplies were in closer balance with demand at the end of the year than they had been since early 1950. This was not true of the refined (2 degree) grade of pyridine, however, which started the year in tight supply and ended the same way.

Prices on coke and coal chemicals were under gov-

TABLE I

Statistical Trends of the Coke Industry in the United States

	1937	1949	1950	1951	1952
Production:					
Oven coke, net tons	49,210,748	60,222,481	66,890,618	71,987,172	63,850,115
Beehive coke, net tons	[1] 3,164,721	3,414,948	5,827,420	7,343,530	4,403,994
Total, net tons	52,375,469	63,637,429	72,718,038	79,330,702	68,254,109
Per cent oven coke	94.0	94.6	91.8	90.7	93.5
Stocks of coke, end of year, net tons	2,595,287	1,769,456	1,110,714	1,482,972	1,901,657
Exports, all coke, net tons	526,683	548,256	397,846	1,026,730	792,072
Imports, all coke, net tons	286,364	277,507	437,585	161,639	312,519
Indicated consumption, all coke, net tons	51,271,929	63,190,665	73,416,519	78,093,353	67,355,871
Disposal, all coke sold or used:					
Furnace coke, net tons	36,751,969	51,514,853	60,918,549	67,440,987	58,182,747
Foundry coke, net tons	2,038,822	2,778,868	3,523,396	3,805,686	3,102,446
Other industrial coke (including producer and water gas), net tons	4,597,894	6,412,672	6,366,497	5,603,262	4,648,077
Domestic coke, net tons	8,107,518	2,755,840	2,565,176	2,087,934	1,932,369
Carbonizing equipment:					
By-product ovens in existence, end of year	12,718	15,104	14,982	15,319	15,608
Beehive ovens in existence, end of year	12,194	13,662	17,708	20,458	17,551
By-product ovens under construction, end of year	259	562	706	398	1,075
Cost of coal charged, oven-coke plants average per ton	$3.74	$8.52	$8.67	$8.94	$9.23
Prices of coke:					
Average realization on oven coke sold (merchant sales):					
Furnace coke	$4.34	$14.09	$14.31	$15.64	$16.29
Foundry coke	$8.47	$19.72	$20.05	$22.19	$22.49
Other industrial coke (including water gas)	$6.08	$13.74	$14.10	$14.44	$14.10
Domestic coke	$6.53	$13.50	$13.60	$14.45	$14.75
Yield of by-products per ton of coal charged:					
Tar, gal	8.67	7.81	7.79	7.78	7.74
Ammonium sulphate or equipment, lb	21.84	20.08	19.89	19.82	19.92
Crude light oil, gal	2.86	2.77	2.81	2.83	2.79
Surplus gas sold or used, M cu ft	6.66	6.35	6.36	6.38	6.35
Average gross receipts for by-products, per ton of coke produced:					
Tar sold and used	$0.502	$0.722	$0.691	$0.757	$0.774
Ammonia and its compounds	$0.326	$0.558	$0.468	$0.501	$0.556
Crude light oil and its deriviatives (including naphthalene)	$0.435	$0.673	$0.871	$1.179	$1.149
Surplus gas sold or used	$1.483	$2.015	$1.977	$1.921	$1.921
Total coal-chemical materials (including breeze)	$2.974	$4.447	$4.508	$4.927	$4.98

ernment control in 1952 and only minor changes occurred. The Office of Price Stabilization issued amendment 13 to SR 13 on November 21, 1952, which allowed an increase of 3.75 per cent in the ceiling prices of coke and coal-chemical products. This order permitted producers to spread the 3.75 per cent increase among their various products, subject to a maximum limit of 10 per cent increase on any one ceiling price. The order also contained a provision requiring that the gross amount of relief granted be apportioned by each producer between coke and coal chemicals in the same proportion in which these products provided sales revenue in the twelve-month period ending April 30, 1952. Although some of the producing companies increased prices on some of their products following issuance of this order, there was no general price advance of an industry-wide basis and averages for the year were not affected.

PRODUCTION OF COKE

The average daily production rate of by-product coke in 1952 was 175,000 tons; the average daily production from beehive production was 12,000 tons. Leading states in the production of by-product coke in the order of their importance were Pennsylvania, Ohio, Indiana, Alabama and New York. Combined, these states produced about 42,405,000 tons or 66.5 per cent of the national production of by-product coke. This compares with 68.2 per cent for the year 1950. The leading producer of beehive coke was Pennsylvania, with 3,750,606 tons or 85.2 per cent of the total beehive production. In 1951 Pennsylvania produced 6,396,480 tons of beehive coke. Of all the coke produced, Pennsylvania was the leading producer with a total of 18,851,304 tons of the total of 68,254,109 tons or 27.7 per cent. This is a slight reduction over the 29.8 per cent share which Pennsylvania had in 1951.

NUMBER AND CAPACITY OF OVENS

At the end of 1952, there were a total 15,608 by-product ovens in existence with a total annual capacity at the end of the year of 76,428 net tons. This is a very slight increase over the 15,319 by-product ovens at the end of 1951 which had an annual capacity of 74,228,400 tons. The largest increase in ovens occurred in Pennsylvania where 251 new ovens with an annual capacity of 1,357,400 tons were completed. The next largest was in Alabama where 125 by-product ovens with an annual coke capacity of 645,300 tons were completed. New York had the most ovens abandoned during the year with 218, and Maryland was next with 120. The 17,551 beehive ovens with an annual capacity of 12,004,800 tons was an appreciable reduction from the 20,458 beehive ovens with an annual capacity of 13,858,900 tons in existence at the end of 1951. There were 480 beehive

TABLE II

Salient Statistics of the Coke Industry in the United States in 1952

		By-product	Beehive ovens	Total
Coke produced — At merchant plants	net tons	11,721,209	(1)	(1)
At furnace plants	net tons	52,128,906	(1)	(1)
Total	net tons	63,850,115	4,403,994	68,254,109
Screenings or breeze produced	net tons	4,639,369	64,261	4,703,630
Coal charged into ovens	net tons	90,909,495	6,911,647	97,821,142
Average value of coal per ton		$9.23	$6.26	$9.02
Average yield in per cent of total coal charged —				
Coke		70.2	63.72	69.77
Breeze (at plants actually recovering)		5.10	2.74	5.04
Ovens — In existence January 1		15,319	20,458	35,777
In existence December 31		15,608	17,551	33,159
Dismantled during year		658	3,235	3,893
In course of construction December 31		1,075	56	1,131
Annual coke capacity December 31	net tons	76,428,000	12,004,800	88,432,800
Coke used by producer — In blast furnaces	net tons	39,636,150	295,669	39,931,819
In foundries	net tons	52,459	.....	52,459
To make producer gas	net tons	479,963	.....	479,963
To make water gas	net tons	953,534	.....	953,534
For other purposes	net tons	358,489	4,011	362,500
Coke sold — To financially affiliated companies —				
For blast furnace use	net tons	9,348,611	1,358,180	10,706,791
For foundry use	net tons	55,034	.....	55,034
For manufacture of water gas	net tons	602,891	.....	602,891
For other purposes	net tons	185,282	.....	185,282
To other consumers —				
For blast furnace use	net tons	5,452,898	2,091,239	7,544,137
For foundry use	net tons	2,804,592	130,361	2,994,953
For manufacture of water gas	net tons	278,820	131,765	410,585
For other industrial use	net tons	1,285,549	367,773	1,653,322
For domestic use	net tons	1,916,609	15,760	1,932,369
Disposal of screenings or breeze —				
Used by producer — For steam	net tons	2,894,374	5,094	2,899,468
To make producer or water gas	net tons	71,682	.....	71,682
For other purposes	net tons	760,473	13	760,486
Sold	net tons	1,131.858	62,293	1,194,151
Average receipts per ton sold (merchant sales)				
Furnace coke		$16.29	$14.36	$15.76
Foundry coke		$22.49	$15.42	$22.18
Water-gas coke		$16.21	$14.70	$15.73
Other industrial coke		$13.64	$14.46	$13.82
Domestic coke		$14.75	$12.95	$14.74
Screenings or breeze		$ 4.32	$ 2.65	$ 4.80
Stocks on January 1, 1952:				
Furnace coke	net tons	1,526,776	22,611	1,549,387
Foundry coke	net tons	15,613	740	16,353
Domestic and other coke	net tons	334,876	1,041	335,917
Screenings or breeze	net tons	754,167	2,526	756,693
Exports	net tons	(1)	(1)	792,072
Imports	net tons	(1)	(1)	312,519
Indicated consumption	net tons	(1)	(1)	67,355,871
By-products produced — Tar	gal	703,889,653	.....	703,889,653
Ammonium sulphate or equivalent	lb	1,781,301,348	.....	1,781,301,348
Gas	M cu ft	922,631,185	.....	922,631,185
Burned in coking process	per cent	35.80	.....	35.80
Surplus sold or used	per cent	62.47	.....	62.47
Wasted	per cent	1.73	.....	1.73
Crude light oil	gal	249,283,837	.....	249,283,837
Yield of by-products per ton of coal —				
Tar	gal	7.74	.....	7.74
Ammonium sulphate or equivalent	lb	19.92	.....	19.92
Gas	M cu ft	10.15	.....	10.15
Crude light oil	gal	2.79	.....	2.79
Coal used per ton of coke	tons	1.42	1.57	1.43
Value of coke at ovens		$925,300,448	$61,282,146	$986,582,594
Value of screenings or breeze		$18,500,418	$135,874	$18,636,292
Value of by-products sold — Tar sold		$37,803,630	.....	$37,803,630
Used by producer		$11,215,852(4)	.....	$11,215,852(4)
Ammonia (sulphate and liquor)		$35,523,713	.....	$35,523,713
Gas (surplus)		$122,982,113	.....	$122,982,113
Crude light oil and derivatives		$68,478,169	.....	$68,478,169
Other coal-chemical materials(2)		$24,453,136	.....	$24,453,136
Total value of coke and breeze produced and coal-chemical materials sold(3)		$1,244,257,479	$61,418,020	$1,305,675,499(5)

(1) Not separately recorded. (2) Naphthalene, tar derivatives, and miscellaneous coal-chemical materials.
(3) Includes value of tar used by producer, and coke and breeze produced.
(4) Estimated from value and gallons used in table.
(5) Values given here do not check with MMS report of $1,244,257,479 which total is less than sum of individual components.

ovens rebuilt in 1951. Of these, 300 were rebuilt in Pennsylvania and 100 in Virginia. There were 56 ovens under construction at the end of the year. About 3,235 ovens in Pennsylvania were reported idle and not expected to resume production.

The big coke oven building program was still under way, and since it was thrown behind by strikes, it had not quite kept up with demand, and this was reflected in the 1,075 new ovens with an annual coke capacity of 5,983,600 net tons under construction as the year ended. This also showed up in the exports and imports of coke. Exports of coke dropped from 1,026,730 tons in 1951 to 792,072 tons in 1952. Imports, on the other hand, increased from 161,639 tons in 1951 to 312,519 tons in 1952. Thus exports exceeded imports for the second straight year.

COAL CHARGED INTO COKE OVENS

In 1952, 97,821,142 net tons of coal were charged into coke ovens. Of this, 90,909,495 tons valued at $839,300,422 or $9.23 per ton were charged into by-product ovens, and 6,911,647 tons worth $43,258,781 or $6.26 per ton were charged into beehive ovens. Included in this figure are 206,860 tons of anthracite coal valued at $1,701,876 or $8.23 a ton which were charged into slot ovens.

The cost of coal (1.42 tons) needed to make one ton of by-product coke was $13.14 in 1952 compared with $12.70 in 1951. Generally, the cost of coal (1.57 tons) required to make one ton beehive coke was $9.82 a ton in 1952, compared with $9.56 a ton in 1951. The percentage of washed coal increased, and of the 90,909,495 tons of coal which were charged into by-product ovens, 49,406,131 tons were washed compared with 51,053,742 tons washed in 1951. The slight drop in actual tonnage of washed coal was due to the overall drop in coke production. The percentage of washed coal went up to 54.3 per cent compared with 49.9 per cent in 1951. At the beehive ovens, 2,377,425 tons were washed of the 6,911,647 tons charged, or 34.4 per cent compared with 17.5 per cent in 1951. The ratio here practically doubled. The leading states in the mining of coking coal in the order of importance are West Virginia, Pennsylvania, Kentucky, and Alabama. Of the 91,199,841 tons which were produced for 51 product ovens, West Virginia produced 32,537,084 tons, Pennsylvania produced 30,110,435 tons, Kentucky produced 12,171,788 tons, and Alabama produced 7,521,119 tons.

COKE PRODUCED AND SOLD OR USED BY PRODUCERS

Blast furnaces used a total of 57,969,044 tons or 86.1 per cent of the 67,355,871 tons of coke used. This is appreciably less than the 66,623,205 tons used in 1951. Drop in usage was due to the steel strike. In spite of this drop, the percentage used in blast furnaces rose from 85.3 to 86.1 per cent. The coke used per net ton of pig iron and ferro alloys dropped from 1,870.7 to 1,865.4 pounds of coking coal per net ton. Since the yield of coke from coal was 69.8 per cent, 2,672.5 pounds of coking coal were used per net ton of pig iron and ferro alloys. Total sales of by-product and beehive coke to other than affiliated companies for blast furnace use was 7,544,137 tons. Coke sold for domestic use totaled 1,932,369 tons, down appreciably from the 2,087,934 tons which were sold for domestic use in 1951.

STOCKS OF COKES AND COKING COAL

According to the reports of by-product coke plants as of January 1, 1953, stocks of furnace and foundry coke totaled 1,542,389 tons; domestic and other coke totaled 334,876 tons for an overall total of 1,877,265 tons at by-product coke. Stocks at beehive coke plants totaled 24,392 tons overall. Thus, stocks of all coke on hand totaled 1,901,657 tons compared with 1,482,972 tons at the end of 1951 or an increase of 29 per cent. Stock of coke breeze at by-product plants totaled 754,167 tons and at beehive coke plants totaled 2,526 tons. This is less than 831,718 tons on hand at the end of the previous year. Stocks of coal remained generally uniform throughout the year. Inventory of bituminous coal at oven coke plants started at 14,827,371 tons in January rose to a peak of 16,894,290 tons in June and at the end of the year dropped slightly to 14,429,783 tons. Inventory of anthracite at oven coke plants at the end of the year totaled 54,720 tons.

GROSS VALUE AND YIELD OF BY-PRODUCTS

The gross value of the by-products sold in 1951, exclusive of the value of the tar used by the producer, and exclusive of the value of the coke breeze produced; but including the value of the surplus gas sold was $289,240,761 or 29.3 per cent of $986,582,594, the gross value of all the by-product and beehive coke produced. Average value of coke breeze and coal-chemical materials was $19.47 per ton of by-product coke produced, consisting of $14.49 for the coke and $4.98 for the coal-chemical materials and breeze. The cost of coal per ton of by-product coke was $13.14. The cost of coal per ton of beehive coke was $9.82 and the value of beehive coke was $13.92 per ton. The average yield of the primary coke by-products was about the same in 1952 as in 1951. In 1952, the average yield of tar decreased from 7.78 to 7.74 gal per ton of coal; ammonium sulphate or equivalent increased from 19.82 to 19.92 lb per ton, crude light oil decreased from 2.83 to 2.79 gal per ton, and the average yield for gas decreased from 10.29 to 10.15 M-cu ft per ton.

DISTRIBUTION OF OVEN AND BEEHIVE COKE

The quantity of coke distributed in 1952 decreased 14 per cent from the record movement of 1951. Work stoppages in the steel industry, when nearly all of the blast furnaces in the United States were banked, virtually stopped the flow of coke to the furnace and curtailed shipments to foundries and other industrial plants. Coke distributed by coke plant operators in 1952 totaled 67,307,141 tons compared with 78,937,869 tons in 1951. As a consequence, deliveries to blast furnaces decreased 14 per cent from the 1951 figure, shipments to foundries dropped 18 per cent, and the quan-

TABLE III

Summary of Coke-Oven operations in the United States in 1952, by States

State	Oven coke							Beehive coke						Total	
	Active plants	Ovens in existence Dec. 31	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens in existence Dec. 31	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	7	1,383	8,269,788	69.07	5,712,102	$66,887,735	$11.71	....	.....	.....	.....	.....	.....	5,712,102	$66,887,735
California	1	135	995,659	61.27	610,080	(1)	(1)	....	.....	.....	.....	.....	.....	610,080	(1)
Colorado	1	266	1,210,678	67.41	816,140	(1)	(1)	20	935	64.00	600	(1)	(1)	816,740	(1)
Illinois	8	910	4,720,529	71.83	3,390,773	57,959,512	17.09	....	.....	.....	.....	.....	.....	3,390,773	57,959,512
Indiana	5	1,960	10,612,392	71.72	7,611,030	139,053,346	18.27	....	.....	.....	.....	.....	.....	7,611,030	139,053,346
Maryland	1	496	3,440,998	72.39	2,490,859	(1)	(1)	....	.....	.....	.....	.....	.....	2,490,859	(1)
Massachusetts	1	204	1,501,547	70.30	1,055,529	(1)	(1)	....	.....	.....	.....	.....	.....	1,055,529	(1)
Michigan	4	621	3,859,733	74.17	2,862,873	44,721,081	15.62	....	.....	.....	.....	.....	.....	2,862,873	44,721,081
Minnesota	3	212	1,197,742	72.51	868,523	14,614,548	16.83	....	.....	.....	.....	.....	.....	868,523	14,614,548
New Jersey	2	341	2,041,129	72.13	1,472,245	(1)	(1)	....	.....	.....	.....	.....	.....	1,472,245	(1)
New York	7	973	6,254,964	69.43	4,342,583	65,232,116	15.02	....	.....	.....	.....	.....	.....	4,342,583	65,232,116
Ohio	15	2,411	13,752,696	70.09	9,638,904	131,405,472	13.63	....	.....	.....	.....	.....	.....	9,638,904	131,405,472
Pennsylvania	14	3,900	21,956,852	68.77	15,100,698	196,491,704	13.01	14,589	5,811,523	64.54	3,750,606	$51,417,946	$13.71	18,851,304	247,909,650
Tennessee	1	44	346,895	73.31	254,319	(1)	(1)	90	.....	.....	.....	.....	.....	254,319	(1)
Texas	2	125	900,539	72.42	652,179	(1)	(1)	....	.....	.....	.....	.....	.....	652,179	(1)
Utah	2	308	1,778,169	63.31	1,125,729	(1)	(1)	797	151,279	56.26	85,111	(1)	(1)	1,210,840	(1)
West Virginia	5	768	5,302,280	71.63	3,798,215	44,519,412	11.72	1,012	468,862	60.56	283,942	4,135,770	14.57	4,082,157	48,655,182
Connecticut, Kentucky, Missouri Rhode Island, and Wisconsin	5	551	2,766,905	73.99	2,047,274	34,523,271	16.86	195	136,594	59.60	81,407	(1)	(1)	2,128,681	(1)
Undistributed	..	.....	.....	.....	.....	129,892,251	15.32	....	.....	.....	.....	2,660,051	15.92	.....	167,075,573
Total 1952	84	15,608	90,909,495	70.23	63,850,115	925,300,448	14.49	17,551	6,911,647	63.72	4,403,994	61,282,146	13.92	68,254,109	986,582,594
At merchant plants	27	2,781	16,225,788	72.24	11,721,209	196,983,761	16.81								
At furnace plants	57	12,827	74,683,707	69.80	52,128,906	728,316,687	13.97								
Total 1951	84	15,319	102,267,417	70.39	71,987,172	1,017,065,551	14.13	20,458	11,418,465	64.31	7,343,530	102,408,135	13.95	79,330,702	1,119,473,686

(1) Included with "Undistributed" to avoid disclosure of individual company operations.

tity destined to industrial plants (other industrial) fell 17 per cent. Although the decline in quantity shipped to the domestic trade (residential heating) in 1952 was not as large as for each of the industrial categories, it was significant that even in a year when consumption for metallurgical purposes was affected by strikes, the domestic trade could not maintain the 1951 consumption rate. The demand for coke used in the manufacture of producer gas and water gas declined in 1952 for the fourth consecutive year due to the greater use of fuel oil and natural gas. The quantity so used (2,446,973 tons) was just about half of the 1948 total. This decline may be attributed to the substitution by gas utilities of natural gas for manufactured gas and the

displacement of coke by natural gas at a number of synthetic ammonia plants.

An analysis of the disposal pattern according to principal end-uses for 1952 showed that nearly four-fifths of all coke and breeze distributed was used for smelting iron ore in blast furnaces. There has been a decided shift in the use of coke in the United States since 1936. In that year, 20 per cent was distributed to the domestic trade (residential heating), while blast furnaces required only 61 per cent and all other industrial uses consumed 19 per cent. Blast furnace requirements increased steadily since that time and the total quantity destined to furnaces in 1952 was nearly double the tonnage shipped in 1936. On the other hand, shipments of domestic coke in 1952 were less than one-fifth of the total distributed in 1936.

CONSUMPTION BY STATES

Coke is a special form of fuel used in numerous industrial applications and consequently has widespread geographic distribution. All states, as well as the Dis-

TABLE IV

Coal-Chemical Materials Obtained from Coke-Oven Operations in the United States in 1952 (1)
(Exclusive of breeze)

Product		Produced	Sales			On hand Dec. 31
			Quantity	Value		
				Total	Average	
Tar	gal	703,889,653	377,147,738	$ 37,803,630	$0.100	31,145,404
Tar derivatives:						
Creosote oil, distillate as such	gal	33,604,537	33,309,079	5,979,715	0.180	1,347,029
Creosote oil, in coal-tar solution	gal	5,817,810	5,533,459	864,880	0.156	145,498
Crude chemical oil	gal	20,403,933	20,460,094	5,732,353	0.280	403,920
Phenol	lb	7,681,341	5,834,187	866,623	0.149	151,520
Pitch of tar:(2)						
Soft	net tons	468,050	3,414	71,708	21.004	5,415
Medium	net tons	14,769	14,668	511,444	34.868	241
Hard	net tons	263,536	25,576	522,911	20.445	835
Other tar derivatives(3)		.....	.....	1,699,423	.....	.....
Ammonia:						
Sulfate(4)	lb	1,604,824,708	1,605,092,441	33,960,125	0.021	81,012,684
Liquor (NH_3 content)	lb	44,119,160	39,451,490	1,563,588	0.040	1,633,287
Total		.....	.....	35,523,713	.....	.....
Sulfate equivalent of all forms	lb	1,781,301,348	1,762,898,401	.....	.....	87,545,832
NH_3 equivalent of all forms	lb	445,325,337	440,724,600	.....	.....	21,886,458
Gas:						
Used under boilers, etc.	M cu ft	(5) 922,631,185	45,479,955	5,939,637	0.131	.....
Used in steel or allied plants	M cu ft		367,510,295	65,939,749	0.179	.....
Distributed through city mains	M cu ft		120,172,674	44,295,161	0.369	.....
Sold for industrial use	M cu ft		43,195,440	6,807,566	0.158	.....
Total	M cu ft	(5)922,631,185	576,358,364	122,982,113	0.213	.....
Crude light oil	gal	(6)249,283,837	14,654,903	3,258,449	0.222	3,990,324
Light oil derivatives:						
Benzol:						
Specification grades (1°, 2°, and 90 per cent)	gal	150,242,163	147,819,994	50,247,002	0.340	5,138,866
Other industrial grades	gal	4,872,164	5,038,680	1,623,237	0.322	144,622
Motor grade	gal	(7)	(7)	(7)	(7)	(7)
Toluol (all grades)	gal	30,522,451	30,345,629	9,181,820	0.303	917,544
Xylol (all grades)	gal	8,093,761	8,037,314	2,564,008	0.319	572,476
Solvent naphtha (crude and refined)	gal	4,681,057	4,624,233	1,087,640	0.235	330,705
Other light oil products	gal	6,188,990	3,935,871	516,013	0.131	340,157
Total	gal	204,600,586	199,801,721	65,219,720	0.326	7,444,370
Intermediate light oil	gal	746,951	750,693	142,540	0.190	56,401
Naphthalene (crude):						
Solidifying at less than 74 C	lb	46,979,403	47,306,112	1,831,714	0.039	2,465,380
Solidifying at 74 and less than 79 C	lb	59,924,103	49,151,700	3,129,943	0.064	31,137,193
Pyridine:						
Crude bases (dry basis)	gal	419,531	422,777	783,238	1.853	115,954
Refined (2°)	lb	1,242,184	1,221,294	1,194,544	0.978	32,169
Picolines	lb	618,757	687,986	237,205	0.345	38,263
Sodium phenolate	gal	2,257,163	2,235,173	564,040	0.252	811,444
Sulfur	lb	8,189,100	8,147,100	108,357	0.013	1,786,000
Other coal-chemical materials(8)		.....	.....	212,498	.....	.....
Value of all coal-chemical materials sold		.....	.....	$289,240,761	.....	.....

(1) Includes products of tar distillation conducted by coke-oven operators under same corporate name. (2) Soft pitch-water softening point less than 110 F; medium pitch-water softening point 110 to 160 F; hard pitch-water softening point above 160 F. (3) Cresols, cresylic acid, fuel oil, pitch coke, road tar, tar paint, and topped, or refined, tar. (4) A small amount of sulfate from purchased synthetic ammonia was produced and sold by two producers but is not included. (5) Includes gas used for heating ovens and gas wasted. (6) 237,312,046 gallons refined by coke-oven operators to make derived products shown. (7) Included with "Other light oil products" to avoid disclosure of individual company operations. (8) Ammonium thiocyanate and secondary oil.

trict of Columbia, used some coke in 1952 and shipments were made to a number of foreign countries. However, as 86 per cent of all coke (exclusive of breeze) consumed in the United States was used for smelting iron ore, states with blast furnace installations were the largest consumers. Pennsylvania, the principal pig iron producing state, led in coke consumption and utilized 26 per cent of the coke and 23 per cent of the breeze in the United States. Ohio retained second place with 19 per cent, followed by Indiana with 9 per cent, Illinois 8 per cent; and Alabama and New York, 7 per cent each. These six states consumed 76 per cent of the coke and 66 per cent of the breeze in the United States.

Blast furnace coke was used in 18 states in 1952 with Pennsylvania and Ohio together consuming almost half of the United States total. The other ranking consumers were Indiana, Illinois, Alabama and New York which combined used 33 per cent. Foundry coke was used in all but two states in 1952. Michigan, the center of the automotive industry in the United States, was the leading consumer followed by Ohio, Illinois, and Pennsylvania. These four states consumed almost half of the total used in foundry cupolas in the United States.

Coke was used in the manufacture of producer gas in eight states in 1952, and in 20 states for water-gas manufacture. There has been a marked change in the consumption pattern of water-gas coke. In 1948, when nearly 4,000,000 tons were used in the United States for this purpose, New York alone used nearly one-fourth of the total. The increased supply of natural gas curtailed the use of coke for making water gas in this state and it dropped behind West Virginia, Virginia, and Ohio in 1952. In the latter states, nearly all water gas was used for chemical synthesis. This market is expected to decline further in the next several years as most of the companies that used coke in 1952 as a starting raw material for making synthesis gas were converting their facilities for the use of natural gas at the end of the year.

Coke classified as "other industrial" was distributed to each state as well as the District of Columbia in 1952. Pennsylvania, Ohio, New York and Michigan were the leading consumers and used 49 per cent of the coke so classified. Coke for residential heating (domestic use) was used in all but 11 states and the District of Columbia in 1952. Massachusetts was the leading state in consumption of "domestic" coke followed by New Jersey, Michigan, and New York, which together consumed about three-fifths of the national consumption.

BREEZE

The term "breeze" is used in the coke industry to designate the smaller pieces of coke which result from screening the major sizes. Breeze of course, has a lower value per ton than the larger sizes and its movement is generally more restricted. About 85 per cent is consumed near the producing sites. As very few beehive plants have screening facilities, oven coke plants produced about 99 per cent of the total breeze distributed in 1952. Pennsylvania, Ohio, Indiana, and New York, in that order, were the leading consumers in 1952, and used 54 per cent of the total distributed. Although a breakdown on the end-use for breeze in each state is not available, data compiled from the annual reports showed that 65 per cent was used for steam raising, 34 per cent for other industrial purposes, and 1 per cent for making producer gas. A market for breeze that has increased in the past several years is in the electrochemical industry, particularly in the manufacture of elemental phosphorus. This use for breeze accounted for the substantial tonnages consumed in Nevada, Florida, and Tennessee in 1952. Production of the coke breeze in the United States in 1952 totaled 4,639,369 tons compared with 5,125,834 tons in 1951. Production of breeze at beehive plants in 1952 totaled 64,261 net tons.

EFFECT OF NATURAL GAS

Marketed production of natural gas in the United States in 1952 was 8,003,309,000,000 cu ft, an increase of 545,950,000,000 cu ft from 1951. This increase is smaller than that reported in 1950 or 1951. Texas, Louisiana, and New Mexico, again in 1952 accounted for the major gains. Production declined in the Appalachian area in California.

The gross addition of natural gas to underground storage of 398,593,000,000 cu ft in 1952 was larger than in any previous year. The rate of increase, however, was less than in former years. The net increase of gas in underground storage during 1952 was 166,536,000,000 cu ft.

Natural gas was consumed in 41 states and the District of Columbia. In each, with the exception of North Dakota and Wyoming, there was an increase in consumption over 1951. Illinois showed the largest increase. Connecticut received natural gas for the first time in 1952. Total consumption in the United States was 7,613,478,000,000 cu ft. The quantities used by various classes of consumers in 1952, and the per cent change compared with 1951 are as follows: residential, 1,621,966,000,000 cu ft or +10 per cent; commercial, 515,669,000,000 or +11 per cent; field, 1,483,754,000,000 cu ft or +3 per cent; petroleum refineries 536,402,000,000 cu ft or 0 per cent; other industrial, 3,623,690,000,000 cu ft or +9 per cent.

The average value of natural gas at the wellhead in 1952 was 7.8 cents per thousand cu ft. This was an increase of 0.5 cents per thousand cu ft in 1952 compared with 0.8 cents in 1951. In Texas and Louisiana, however, the increase in average value was larger in 1952 than in 1951.

The average value at point of consumption for the United States in 1952 was 33.2 cents per thousand cu ft, 3.4 cents higher than in 1951.

Natural gas was imported into the United States for the first time since 1939. Interstate shipments and exports of United States natural gas increased 17 per cent. The increase in interstate shipments in 1952 nearly equaled the increase in marketed production.

The number of residential consumers climbed 1,100,000 to 22,600,000. The number of commercial consumers increased 200,000 to 1,900,000. Included in the number of consumers are 4,500,000 residential and 300,000 commercial consumers of mixed gas.

By F. H. WICKLINE, Electrical Engineer, National Tube Div., United States Steel Corp., Pittsburgh, Pa.

SPEED REGULATION FOR TANDEM TUBE MILL DRIVES

. . . . successful operation of this mill has shown that electronic control can be successfully used under the tough operating conditions of the steel industry . . . .

▲ IN the manufacture of seamless steel pipe, the process known as "stretch reduction" offers certain economic advantages. By this process the number of sizes of shells from the rolling mill is considerably reduced, making it possible to operate the piercing and rolling mills for long periods of time on one size of product, thereby avoiding time-consuming changes in mill set up.

For example, the No. 4 Seamless Mill recently installed at the Lorain Works of National Tube Company incorporates the use of a 12-stand stretch-reducing mill producing pipe ranging in size from 2⅜ to 3½-in. outside diameter from a common shell size of approximately 5-in. outside diameter. This mill has the capability of producing pipe up to 4½-in. outside diameter by using it as a sinking-sizing mill; however, this is rarely done inasmuch as other facilities have been provided to take care of the sizes between 3½ and 4½-in. outside diameter.

At this point it is appropriate to clarify the difference between stretch-reducing and sinking-sizing. A sinking-sizing operation incorporates little, if any, tension between stands and generally limits the amount of diameter reduction to a maximum of 3 per cent per stand. Diameter reductions exceeding this tend to produce a multi-sided inside diameter, unless tension is introduced between stands. The application of tension results in a more uniform appearance of inside surface in addition to a reduction of wall thickness. This wall reduction can be controlled within limits by controlling the amount of tension between stands. This operation then is no longer called sinking-sizing, but is known as stretch-reducing.

In general, the product from a sinking-sizing operation will have a heavier wall thickness than the ingoing shell, while the product from a stretch-reducing operation may have a lighter wall thickness than the ingoing shell. By controlling the amount of tension between stands of a stretch-reducing mill, it is possible to produce tubes of several different final wall thicknesses from the same wall thickness of the ingoing shell.

This particular advantage extends back to the primary mills, inasmuch as billet mills may limit their production to a limited range of sizes, and thus operate for extended periods on one size of billet.

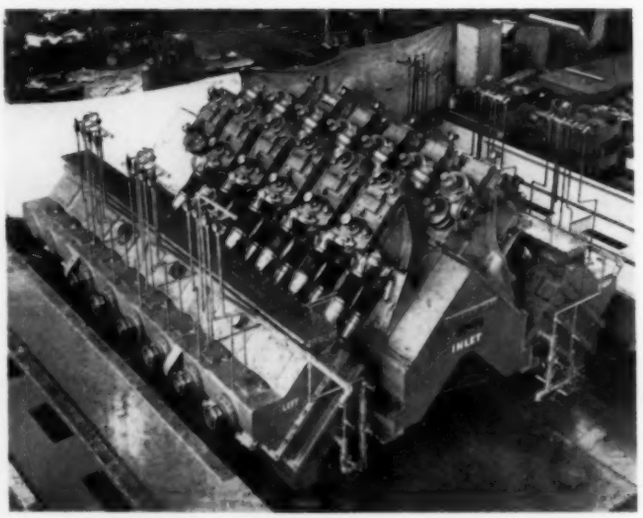
In the production of seamless pipe by this method, stretch reduction takes place in a tandem mill of usually from 12 to 16 stands, each stand having its work roll axis 90 degrees to the axis of the work rolls of adjacent stands. Figure 1 shows arrangement of a typical mill. Each stand is individually driven by a d-c motor through bevel gearing.

In such a mill, pipe from a reheat furnace is fed at as close intervals as possible into the reducing mill, where by having the proper groove size for successive stands and the proper amount of tension between stands, elongation and diameter reduction take place, with change in wall thickness as desired.

During this operation, it is of utmost importance to maintain the proper speed relationships between stands to prevent stretching and rupture of the tube between stands or to prevent compression or "ballooning" between stands.

In maintaining proper speed relationships there are two separate problems to consider: first, impact or

Figure 1 — Shop view shows 12-stand stretch reducing mill and the motor bases.



transient speed drop which occurs when the end of the shell first enters a given stand, and second, steady state speed variation which results from bus voltage variation, or temperature and metallurgical variations in the shell during the time the tube is in the mill stand. During the transient speed drop period when the tube first enters the roll, the suddenly applied

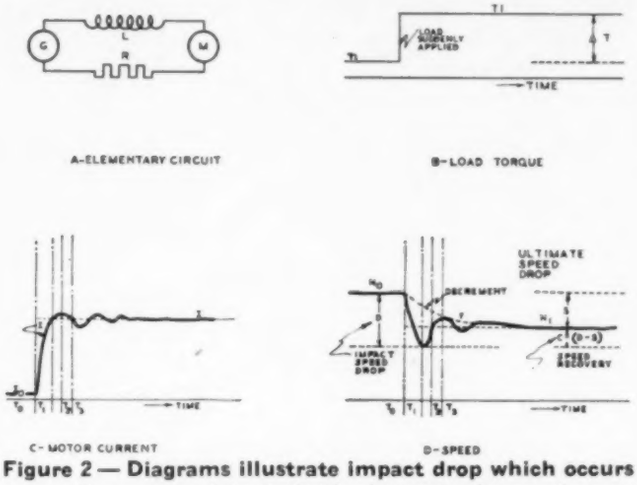


Figure 2 — Diagrams illustrate impact drop which occurs as d-c motors drive individual stands of a continuous mill.

load causes the motor speed to drop, followed by speed recovery.

Several earlier papers have described the theory of transient speed drop in d-c motors, and Figure 2, taken from the paper "speed transients of d-c rolling mill motors" by T. M. Linville and L. A. Umansky, Trans. AIEE, Vol. 54, 1935, pp 387-394, shows the behavior during the transient period.

The impact speed drop "D," shown in Figure 2 is the product of the IR drop and the ratio t_l/t_s where t_l is the electrical time constant L/R, and t_s is the speed time constant:

$$\frac{2\pi}{60}\left(\frac{WK^2}{32.2}\right) \times \left(\frac{R}{7.05\ Kv^2}\right)$$

Where: R is the armature circuit resistance
Kv is motor CEMF per RPM

This relationship is shown graphically in Figure 3.

This shows the impact speed drop in a given motor

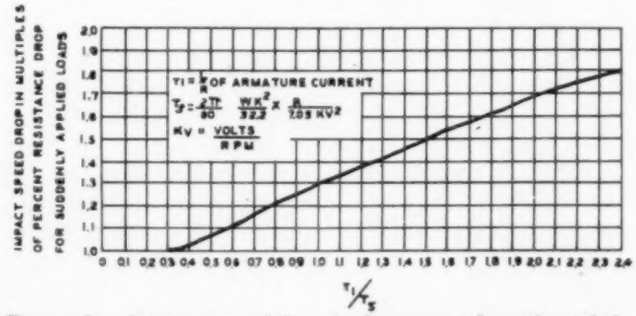

IMPACT SPEED DROP IN MULTIPLES OF PERCENT RESISTANCE DROP FOR SUDDENLY APPLIED LOADS
T1 = L/R OF ARMATURE CURRENT
Ts = 2π/60 WK²/32.2 × R/7.05 Kv²
Kv = VOLTS/RPM
T1/Ts

Figure 3 — Impact speed drop is shown as a function of the time constant.

to be a function of that motor's ability to build up electrical torque, and of its ability to develop torque from its stored energy.

Therefore, in the design of motors for driving stretch mills, great care must be given to keeping the value of the ratio t_l/t_s as well as the IR drop as low as possible. The result is in most cases a premium motor having a thermol capacity much greater than calculated load requirements. Figure 4 shows how impact speed drop varies with size factor.

A specific example of such a design is the 12-stand reducing mill recently installed by National Tube Company as part of the new No. 4 seamless mill at Lorain, Ohio.

As previously mentioned, in this mill finished size pipe varying from 2⅜ to 3½-in. outside diameter are made from a single entering size pipe of approximately 5-in. outside diameter. The mill is comprised of twelve stands each having 2-high overhung rolls of 14-in. diameter on 14½-in. centers, with each stand being driven by a 200-hp low impact speed drop motor.

These motors, operating at 600 volts d-c have a speed range of 850/1700 rpm. They have calculated values of t_l and t_s of 0.00923 and 0.0333 respectively and a calculated value of impact speed drop of 2.23 per cent. This compares with t_l and t_s values of 0.0812 and 0.00712 respectively for standard mill type motors, and with an impact speed drop of 6.26 per cent.

Thermally these motors are good for approximately 350 hp, and are roughly 80 per cent larger physically than a standard motor.

For voltage and speed regulation under steady state conditions, the control for these motors incorporates

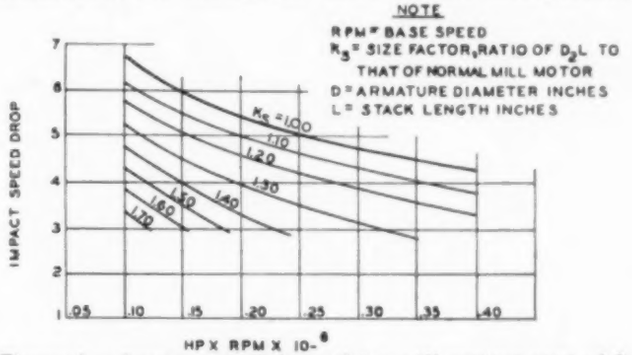


Figure 4 — Impact speed drop of d-c mill motors vary with the rating and size.

very elaborate voltage and speed regulating equipment consisting of both electronic circuits and rotating regulators. Since speed relationships during steady state conditions are of utmost importance, it is worthwhile to examine in some detail the control by which this regulation is accomplished.

The speed regulating equipment, shown schematically in Figure 5, consists basically of a balanced d-c amplifier driving the buck-boost fields of a rotating regulator which excites the motor fields. This circuit compares voltage between a sensitive tachometer generator and a voltage reference pilot generator. The tachometer signal is amplified by 101 AVT and fed into the second stage amplifier 101 BVT, which controls the grid of power amplifier tube 102 VT.

Under balanced conditions, the grids of 102 VT and 103 VT are at the same potential and these tubes conduct equally. The differentially connected boost-buck fields then cancel each other resulting in zero net excitation. Any deviation of tachometer voltage from standard causes the grid potential of 102 VT to change, resulting in more or less current in the bucking field

with a resulting net flux which will cause the motor field exciter to raise or lower the motor speed until the tachometer voltage again balances the reference voltage.

in 101 AVT and 101 BVT which causes an increase or decrease in the effect of the boost field.

In actual operation, no observable speed or voltage variations occur during the steady state period. This

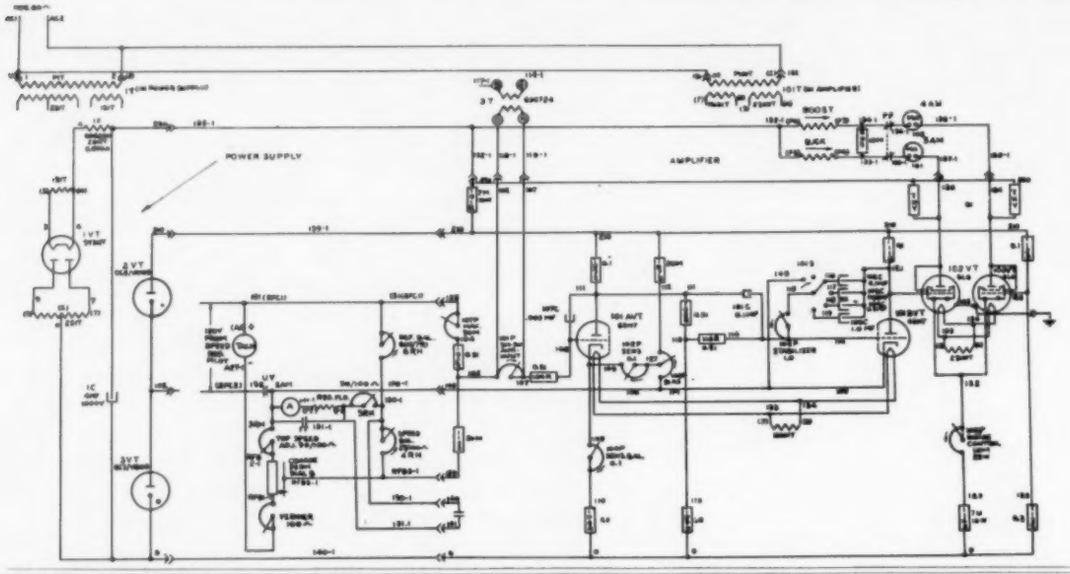


Figure 5 — Detail drawing shows electronic speed regulator

The bus voltage regulator shown in Figure 6 is essentially the same, except that instead of the tachometer signal causing a change in grid voltage in the tube supplying the boost field, a signal proportional to bus voltage causes the change.

The manner in which this is accomplished brings out an interesting application of a magnetron tube, which is conventionally used as an UHF oscillator.

statement is based on standard recording instrument readings which are not sensitive enough to show extremely fast or minute changes.

Plans are now being made for detailed oscillographic studies of the mill to determine just how effective the equipment is in preventing minute speed or voltage deviations. It is hoped that a report can be given on this at a later date, as much data should result perti-

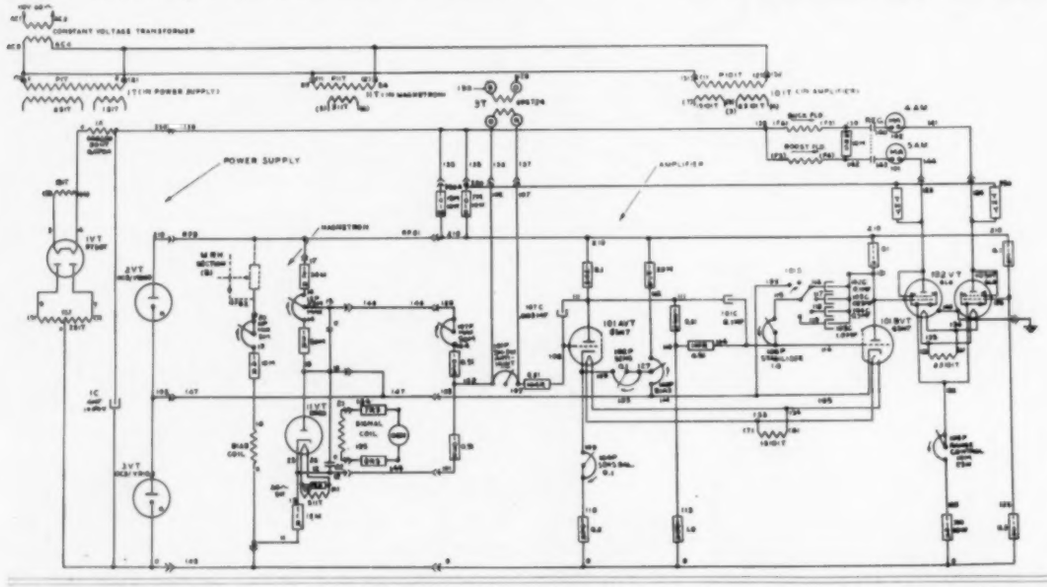


Figure 6 — Detail drawing shows electronic voltage regulator.

In this application, the magnetron is a kinotron diode whose envelope is surrounded by two magnetic coils, the axes of which are paralleled to the cathode element. One of these, the bias coil, is excited from the voltage reference composed of two glow tubes. The second coil, which is the signal coil, is excited from the bus voltage.

Since in the magnetron the number of electrons in motion between cathode and plate depends on the net ampere turns of the surrounding coils, any change in the bus voltage results in a change in the plate current of the magnetron. This causes a change in grid voltage

nent to tandem pipe mill motor and control application, as well as information pertinent to the physics of stretch reduction. If the resulting product is any criterion, the motors and control as applied have been completely justified, as continuing large tonnages of superior quality seamless pipe are being produced.

Electrical equipment maintenance has been at a minimum with only a negligible amount of vacuum tube replacement.

Mill maintenance people, who normally shy away from electronic gadgets, have been given a new concept of electronic control reliability, paving the way for wider usage.

Allegheny Ludlum

BRACKENRIDGE

WEST LEECHBURG

By T. J. Ess

. . . . a major portion of the company's $80,000,000 program went into the Brackenridge and West Leechburg plants to further the change from sheet rolling to strip rolling . . . .

▲ THE valleys of the Allegheny and Kiskiminetas Rivers have long been prominent in the history of the iron and steel industry. One of today's important producers began there in 1901, when Harry E. Sheldon, with his father-in-law Captain Alfred Hicks, organized the Allegheny Steel and Iron Co., and built a plant at Brackenridge, Pa. Starting with one open hearth furnace, one bar mill and four sheet mills, it was reorganized as Allegheny Steel Co., and in 1905 added a plate mill and steel casting shop.

Through subsequent mergers with Interstate Steel Co., Reliance Tube Co., Western Tool and Forge Co., and West Penn Steel Co., all located nearby, the company acquired additional facilities, as well as land for expansion. In 1930, with a productive capacity of 180,000 tons annually, Allegheny acquired the Lamination Stamping Co., of Hartford, Conn., and moved the operations to Brackenridge.

Meanwhile, at West Leechburg, 15 miles away, another company was fluorishing. Founded in 1897 as West Leechburg Steel and Tin Plate Co. and later renamed West Leechburg Steel Co., this company produced strip steel. By 1925, this plant had open hearth furnaces and strip mills capable of producing 180,000 tons of hot rolled steel and 40,000 tons of cold rolled steel per year.

In 1936, the West Leechburg plant was absorbed by Allegheny Steel Co., which in 1938 merged with Ludlum Steel Co. (organized in 1854) to form Allegheny Ludlum Steel Corp.

Allegheny, from its very beginning, depended on specialty products rather than the more competitive

carbon steels. In 1902 the company pioneered the production of silicon-iron alloys, which became one of its principal products. Tool steels and die steels were also developed, and the company pioneered in low carbon stainless steels for general use. The merger with Ludlum, also a pioneer and producer of specialty steels, resulted in the largest producer of stainless and high alloy steels in the world.

Since World War II the company has spent some $80,000,000 in improvements and expansions with a view to making the company as self-contained as possible. A major portion of this went to Brackenridge and West Leechburg, the plants with which this article deals, with the object of further converting from sheet rolling to strip rolling.

Before discussing details of the equipment installed in these plants, it should be emphasized that all equipment is designed specifically for the production of highly alloyed steels. Also, plans were shaped somewhat by the available space, and with the ideas of duplication of equipment, of using some parts of an existing mill and of eliminating certain design elements, such as reduction gear sets, etc., insofar as possible which resulted in greater power efficiency, reduced maintenance and lower spare parts inventory.

STEELMAKING

Brackenridge, the largest plant of the company, covers 100 acres and employs about 5500 people. Steelmaking facilities consist of two electric furnace shops and an open hearth shop, rated respectively at 506,700 and 240,000 net tons per year.

There are 13 basic arc furnaces in all, 9 in the old shop and 4 in the new one. Details of these units are given in Table I.

All furnace roofs are of silica brick laid in straight rings without bond. Double faced corrugated cardboard is used to provide an expansion allowance of $\frac{3}{16}$ in. per sq ft of area.

Except for the 10-ton furnaces, side walls are of basic brick, 13½ in. thick above the sill line and 18-54 in. thick below the sill line. The small units are lined with basic brick up to the sill line and silica brick above.

All furnaces have disconnect switches with interlocks between the switches and the breakers. All operating panels have an ammeter on each phase, wattmeter, watt-hour meter, breaker control switch, tap changing control switches, load control rheostats, electrode motor control switches and indicating lights.

The nine furnaces in the old shop set up a total 15-minute demand of 28,800 kw, while the four furnaces in the new shop combine in a 40,750 kw demand.

The product of the electric furnaces covers a wide range of grades, including tool steels, stainless steels, silicon steels and some carbon steels. Hence, furnace practice also varies widely. The charge is, of course, principally scrap, with perhaps some pig iron or cast iron scrap should the carbon specification require it. Burnt lime is used as the fluxing agent. For stainless grades the furnaces are charged somewhat lighter than for carbon grades, and the flux increased somewhat.

Both single and double slag practice is employed, and the slags may vary in lime-silica ratio from 1.2:1 to 2.0:1.

Ferro-alloys are used as required to meet customer specifications. Spiegel is used as a furnace block on killed steels. In stainless heats, scrap and ferrochromium are used as the source of chromium. Nickel is obtained from scrap, sinter, oxides or electrolytic nickel, as available.

The modern, large furnaces produce heats of carbon steel in about 6 hr, tap to tap, producing about 14.5 tons per hr. On stainless, the heat time is about 7 hr, tap to tap, or about 7.9 tons per hr. Power consumption averages 400-500 kwhr per ton of steel, depending on the type of product.

Heats tapped from the electric furnaces are actually about 20 per cent larger than the nominal capacity of the furnaces. Steel is poured in a variety of flat and corrugated ingot molds. Big-end-up ingots range from 13 x 18 in. up to 30 x 30 in., 17 x 53 in., and 23 x 42 in., while big-end-down ingots run 18 x 34 in., 23 x 42 in., and 26 x 47 in.

The old electric furnace building is 850 ft long, with an 80-ft furnace aisle served by one 50/5- ton crane, three 25/10-ton cranes, and two 15/10-ton cranes. The 76-ft scrap aisle contains three 25/10-ton cranes. In this shop, the 25-ton, 35-ton and 50-ton furnaces are tapped into ladles carried on cars over tracks spanning pouring pits. The ingot molds are placed in the pit and filled as the ladle in its car comes above them. The 10-ton furnaces are tapped into ladles carried by overhead crane.

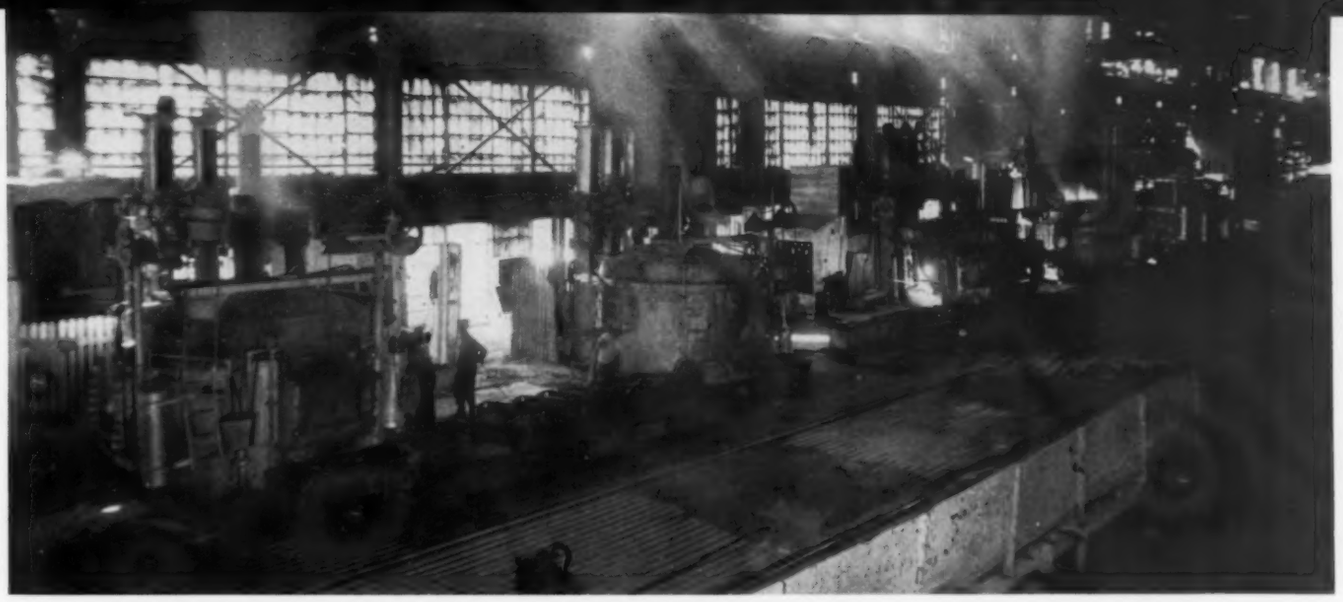
The new shop, 700 ft long, has a furnace aisle 96 ft wide with three 125/25/5-ton cranes, and a 96-ft scrap aisle served by one 110/20 ton crane and three 15-ton cranes. In this shop, the ladles are handled by overhead crane, and steel is poured into ingot molds resting on buggies.

H. G. BATCHELLER
Chairman

E. J. HANLEY
President

CLARK W. KING
Executive Vice President

C. B. POLLOCK
Vice President—Production



The original electric furnace shop contains nine arc furnaces ranging in nominal size from 10 to 50 tons.

The open hearth department contains five basic furnaces, varying somewhat in size and capacity. Three furnaces, rated at 115 tons, have hearths 37 ft long x 15 ft 6 in., one 100-ton furnace has a 35 ft x 14 ft 6 in. hearth, and one 90-ton unit, a 32 ft 6 in. x 13 ft 6 in. hearth. The bottoms of all of these furnaces consist of 2½ in. of firebrick against the pan, topped by 7 in. of chrome brick, 5 in. of rammed subhearth and 10 in. of magnesite. Backwalls are straight and built of basic brick. Furnace roofs are of 12-in. silica brick, with 15-in. ribs.

The furnaces are fired entirely with natural gas, which is introduced at low pressure through a 4-in. pipe entering each side wall of the port. Air for combustion is provided for each furnace by a 12,000-cfm fan. Each furnace is equipped with recording instruments on gas and air flow, flue temperatures and furnace pressure.

Open hearth furnaces are operated on cold charges of scrap and pig iron. The product, chiefly silicon steel, is for the greater part poured into 19 in. x 35 in. x 70 in. ingots.

The furnaces are tapped into ladles carried on cars which run on tracks at right angles to the line of furnaces. These tracks span pits in which the ingot molds are placed, and teeming is carried out in a manner similar to that in the old electric furnace shop.

Slag, running approximately 400 lb per ton of steel, is taken in thimbles to a cinder building where it is broken up and then removed by railroad car or truck.

Ingot molds are cleaned by scraping and then sprayed internally with mold wash.

The open hearth building, about 510 ft long, is made up of a 74-ft charging bay with three cranes 10-25 tons in capacity, and an 80-ft pouring bay with three 15-ton cranes. The stockyard, 550 ft long x 80 ft wide, contains two 15-ton cranes, and the mold yard, with one 10-ton crane, is 160 ft long x 67 ft wide.

In both electric furnaces and open hearth furnaces, oxygen is used in the furnace baths for carbon reduction. It is introduced at 40-100 psi pressure through an uninsulated 1-in. pipe. Consumption runs 300-450 cu ft per ton of steel. The oxygen is supplied for this use, as well as for maintenance purposes, by four 50,000-cu ft liquid oxygen converters and a 500,000 cu ft storage tank.

Ingot stripping facilities consist of seven hydraulic pusher type units (three at the old electric furnace shop, three at the new shop and one more nearby) and two stationary strippers (one for big-end-up ingots, one for big-end-down) at the soaking pits.

BLOOMING MILL

An important unit in the modernization program is a new blooming-slabbing mill and some additional soaking pits. Ingot heating facilities now total 35 holes. There are 16 regenerative pits arranged in four blocks, each hole being 10 ft long, 4 ft 6 in. and 5 ft 9 in. wide,

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The new shop contains two 60-ton and two 70-ton arc furnaces. Controls for these furnaces are located in small shelters away from the transformer houses.

and 7 ft 1 in. deep. Three more blocks contain 11 recuperative pits, 13 ft 3 in. long x 5 ft 9 in. wide x 11 ft 3 in. deep, heated by burners at the top of one end wall. Eight circular, tangentially-fired pits, 13 ft in diameter and 7 ft deep, complete the furnace installation. The three types of pits are installed essentially in three parallel rows, all at right angles to the mill line.

All pit furnaces are fired with natural gas, with fuel oil as a stand-by on the recuperative and circular units. The regenerative pits are all manually operated. The recuperative and circular pits are equipped with forced draft fans and automatic control of temperature, fuel-air ratio and furnace pressure.

Heated ingots are removed from the pits by stiff leg pit cranes and placed in a buggy which is then moved by a 25-ton diesel locomotive to the blooming mill approach tables, which extend for about 65 ft to the mill. The approach table operates under adjustable voltage control.

The blooming mill is a 40-in. two-high reversing unit with closed top type housings, each post offering a cross-sectional area of 430 sq in. Cast alloy steel mill rolls, 33-38 in. in diameter, operate in 25 in. x 25-in. babbitted bearings. The 92-in. barrel of the usual rolls carries a 45-in. bullhead and passes of 13½ in., 9 in., 6⅛ in., and 3 13/16 in. Rolls with a wider bullhead are used when rolling wide slabs.

The rolls are hydraulically balanced through 600-psi cylinders mounted on the mill housings, and are raised and lowered at speeds up to 43 fpm by two 14-in. mill screws of 2-in. pitch, driven by two 100-hp, 230-volt mill type motors operating in parallel under adjustable voltage control. Maximum roll lift is 52¼ in.

Two rack-operated cast steel side guards are provided on each side of the mill, driven by four 100-hp mill type motors under adjustable voltage control. The right hand entry guard carries manipulator fingers, actuated by a 75-hp motor, for turning the piece on the table.

The mill is driven by twin motors, each rated at

Open hearth furnaces are tapped into ladles carried by cars which run over pits in which the ingot molds are placed.

The newer soaking pits are equipped with automatic control of temperature, fuel-air ratio and furnace pressure.

3000 hp, 600 volts, 40-100 rpm, under adjustable voltage control. Power is supplied to these motors from a motor-generator set consisting of three 1750-kw, 600-volt d-c generators driven at 514 rpm by a 4500-hp, 6600-volt wound rotor induction motor controlled by slip regulator. The set also carries a 102,000-lb flywheel of laminated plate construction, 17 in. wide and 13 ft 4 in. in diameter.

The drive develops normal torques of 787,000 lb-ft at 40 rpm, and 314,500 lb-ft at 100 rpm. Peaks are developed up to 2,160,000 lb-ft. Each drive motor is connected directly to a mill roll by a 19-in. forged alloy steel spindle, supported by bronze segmental slippers.

Power for the mill auxiliaries operating under adjustable voltage comes from two motor-generator sets, each consisting of five 230-volt d-c generators (two of 100 kw, one 150 kw and one 25 kw) driven by a 550-hp, 2300-volt, 1200-rpm synchronous motor.

The blooming mill is designed to roll slabs 2-9 in. thick and up to 51 in. wide or blooms up to $11\frac{1}{2}$ x $11\frac{1}{2}$ in. from ingots ranging 12 in. x 12 in. x 60 in. (2200 lb) to 26 in. x 57 in. x 80 in. (22,000 lb). Slabs form approximately 95 per cent of the product. Blooms rolled at Brackenridge are sent to other plants of the company for further rolling.

With rolling speeds of 400-1000 fpm, this mill averages about 150 tons per hr. Silicon steels are rolled at a rate of 160 tons per hr, while the rate on stainless grades is about 80 tons per hr. A typical reduction schedule for a 19 x 35-in. silicon steel ingot to a 5-in. slab calls for two edging passes, six slabbing passes, followed by two more edging passes and a final slabbing pass.

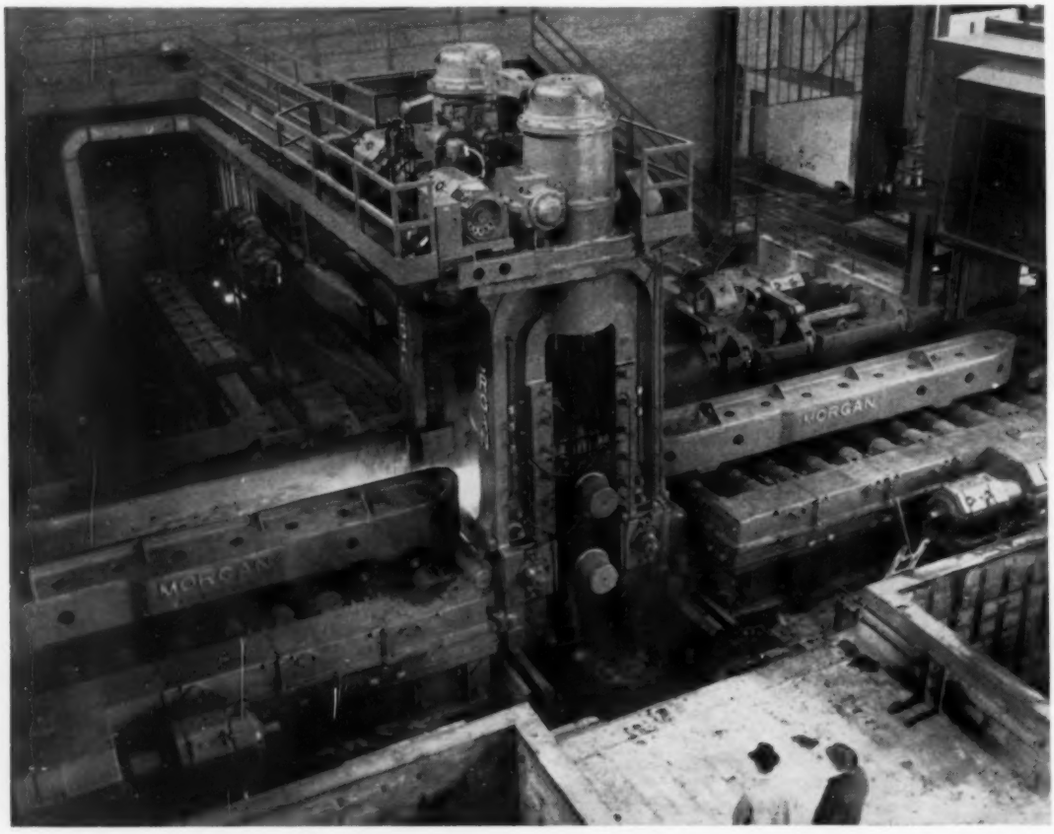
From the mill, slabs pass over tables operated under adjustable voltage control to a 1200-ton hydraulic-electric shear 98 ft away. Powered by two 150-gpm, 2500-psi pumps driven by 250-hp a-c motors, the shear

TABLE I
Electric Arc Furnaces

	Old shop					New shop	
No. of furnaces	2	2	2	2	1	2	2
Year installed	1927—1928	1929	1935—1937	1941	1947	1949—1950	1949
Nominal capacity, tons	10	10	25	35	50	60	70
Shell diameter, ft-in.	11—6	11—6	15—0¾	16—0	17—0	17—0	18—0
Shell height, ft-in.	7—1⅝	7—1⅝	9—0	9—8	11—7	11—9	11—9
Shell thickness, in.	⅞	⅞	1	1⅛	1⅛	1¼	1¼
How fabricated	Riveted	Riveted	Riveted	Riveted	Welded	Welded	Welded
How charged	Door	Door	Door	Top	Top	Top	Top
How tilted	Hydraulic	Motor	Motor	Motor	Motor	Motor	Motor
Roof thickness, in.	9	12	12	12	12	12	12
Transformer kva	2500	3000	7500	10,000	12,000	11,500	16,000
How cooled	Water	Water	Water	Water	Water	Water	Water
Primary voltage	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Secondary voltages	186	186	280	290	265	340	350 350
	135	135	215	215	243	270	312 276
	89	89	162	167	199	200	276 236
			124	124	153	160	202 202
					128		180 180
							160 160
Tap changing	①	①	②	②	②	②	②
Circuit breakers:							
No. per furnace	4*	4*	1*	1*	1*	1†	1†
Type	Oil	Oil	Oil	Oil	Oil	Air	Air
Capacity, amp	300	300	600 400	600	600	1200	600
kv	35	35	34.5 37	34.5	34.5	23	23
Furnace leads:							
Type	Ribbon bus	Ribbon bus	Cable	Cable	Cable	Cable	Cable
How cooled	Air	Air	Air	Water	Water	Water	Water
M cir mils per phase	160	160	24 x 1500	9 x 1500	9 x 1500	9 x 1500	24 x 2000
Electrode diameter, in.	12	....	....	....	....	....	18
Type of regulator	Balanced beam	Balanced beam	Balanced beam	Rotating	Rotating	Rotating	Rotating
15-min demand, kw	2000	2100	6000—6800	9100—7900	8800	10,000—10,500	14,800—14,100

① Three tap changing breakers. ② Motor-driven tap changer in transformer tank.
* One oil breaker backs up all of these oil breakers. † One oil breaker backs up both of these air breakers.

is capable of cutting blooms up to 16 in. x 16 in. or slabs up to 54 in. x 6 in. in section. An overhead motor-operated shear gage can be set for any desired length from 3 ft to 18 ft. Crop ends are deflected by a hydraulically operated switch into double scrap buckets in a pit beneath the shear.



Many special design features are incorporated in the 40-in. blooming mill to take care of the requirements of the special steels rolled.

Beyond the shear is a kick-off and transfer, from which blooms or slabs not intended for direct rolling into strip may be removed by crane and taken to the conditioning and storage area.

Blooming mill drive motors, their motor-generator set, auxiliaries, control boards and switchgear are located in a 92 ft x 135-ft motor room beside the mill. The rotating equipment is cooled by down-draft ventilation in a closed system with heat exchangers. Make-up air is supplied to the system through a 96,000 cfm electro-static precipitator.

STRIP MILL

The plant's rolling facilities have been further expanded by the installation of a 56-in. semi-continuous hot strip mill, in line with the blooming mill, on the site of a seven-stand 36-in. mill built in 1932. The new mill is designed to roll carbon, silicon and high alloy steels. Slabs may range 12-51 in. in width, 3-9 in. in thickness, and 5½ to 17 ft in length for reheated slabs or up to 32 ft in length in direct rolling. Slab weights range 2000-14,000 lb in weight averaging about 8000 lb. The mill produces strip in widths up to 51 in. down to No. 14 gage, and up to 42 in. wide for No. 16 or 18 gage.

Most of the silicon steel slabs are rolled direct from the blooming mill. Alloy slabs are taken from the bloomer to the conditioning yard. Powder scarfing is used to condition these slab edges, and swing frame grinders remove defects from the surfaces.

There are two slab heating furnaces, differing radically in design and capacity. Both units are completely insulated and steel-encased and have flat, suspended roofs. Both are fired with natural gas, with fuel oil as a stand-by. Neither furnace is recuperative. The first of these is of conventional triple-zone design, with a 50 ft x 18 ft 3 in. hearth. Eight burners are located in both top and bottom of the heating zone, and eight more in the top of the soaking zone. Each firing zone is equipped with automatic control of temperature, fuel, input and fuel-air ratio, and furnace pressure is also automatically controlled. This furnace has a heating capacity of 35 tons per hr on stainless steels and 45 tons per hr on other grades.

From the slab storage area, overhead cranes deposit 25-ton loads upon stationary grates located at the back of each furnace. Two double pusher rams, each driven by a 75-hp mill type motor and equipped with disappearing dogs, are provided for each furnace, and act to

The blooming mill motor room is ventilated by a closed recirculating system, with make-up air cleaned by a precipitator.

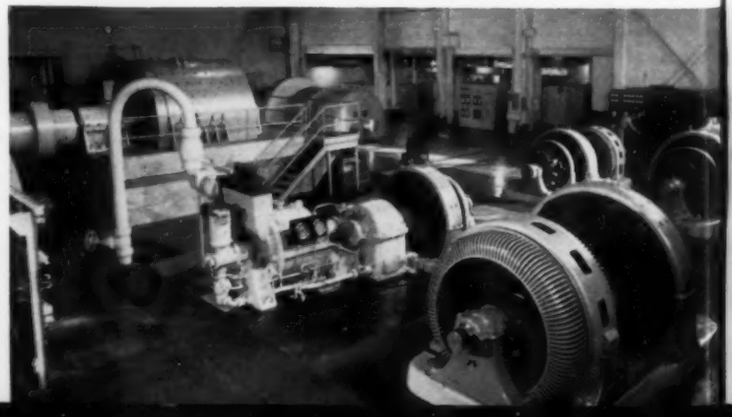


TABLE II

Brackenridge Strip Mill Data

Stand	2-high or 4-high	Work rolls		Back-up rolls		Distance from preceding stand, ft-in.	Motor data					Gear ratio	Roll, rpm		Strip speed, fpm		Screwdown motors (all 230 volt d-c)		
		Length, in.	Diam, in.	Length, in.	Diam, in.		Hp	Voltage	Type	Min rpm	Max rpm		Min	Max	Min	Max	No.	Hp	Rpm
56-in. Semi-continuous hot strip mill																			
No. 1 Scalebreaker	2	56	26	56			2000	6600	Syn.	257.14		3.16:1	81.5		513	555	2	40	550
Integral edger	Vertical		24				250	230/600	d-c	375	1050	6:1	62.5	175	392	1100	1	75	515
Universal rougher	2	56	36	56		36-0	6000	600	d-c	50	120	Direct	50	120	478	1145	1	150	460
No. 2 Scalebreaker	2	56	25	56		190-4	500	600	d-c	300	600	6.36:1	47.2	94.4	309	618	1	15	725
No. 1 Finisher	4	56	24½	56	53	14-8	(2) 2000	600	d-c	250	500	5.24:1	47.7	95.4	306	612	2	75	515
No. 2 Finisher	4	56	24½	56	53	18-0	(2) 2000	600	d-c	250	500	3.91:1	64	128	410	820	2	75	515
No. 3 Finisher	4	56	24½	56	53	18-0	4500	600	d-c	85	170	Direct	85	170	545	1090	2	75	515
No. 4 Finisher	4	56	24½	56	53	18-0	4500	600	d-c	110	220	Direct	110	220	705	1410	2	75	515
No. 5 Finisher	4	56	24½	56	53	18-0	4500	600	d-c	135	270	Direct	135	270	865	1730	2	75	515
No. 6 Finisher	4	56	24½	56	53	18-0	3000	600	d-c	150	300	Direct	150	300	961	1922	2	75	515
56-in. Tandem cold mill																			
Feed reel	4	20					(2) 60 kw	250	d-c	250	1000	2.75:1	91	363	475	1900			
No. 1	4	56	16½	54	53		(2) 1250	600	d-c	100	300	Direct	100	300	432	1296	2	75	515
No. 2	4	56	16½	54	53	13-0	(2) 2000	600	d-c	135	380	Direct	135	380	583	1642	2	75	515
No. 3	4	56	16½	54	53	13-0	(2) 2000	600	d-c	175	470	Direct	175	470	756	2030	2	75	515
No. 4	4	56	16½	54	53	13-0	(2) 1750	600	d-c	200	500	Direct	200	500	864	2160	2	75	515
56-in. Reversing cold mill																			
Feed reel		20					100 kw	250	d-c	200	1040	6.25:1	32	166	168	870			
Leveler		56	8				75	250	d-c	515	655	15.7 :1	33	42	69	88			
Tension reel		20					(2) 500	600	d-c	250	1060	4.2E:1	59	250					
Mill	4	56	16½	54	53		(2) 1750	750	d-c	175	350	4.05:1	43	86	596	1192	2	75	515
Tension reel		20					(2) 500	600	d-c	250	1060	4.25:1	59	250					
56-in. Skin pass mill																			
Feed reel							50 kw	250	d-c	200	1000	13.3 :1	15	75					
Mill	2	56	28				250	250	d-c	575	1150	28:1	20.5	41.0	150	300	2	15	725
Tension reel							75	250	d-c	200	1000	13.3 :1	15	75					

push the bottom slab of the pile through a manually adjusted gate onto the furnace skids.

The second furnace, designed specifically for the special alloys which form so much of this mill's production, has a hearth 96 ft x 19 ft 3 in. and is divided into three heating zones, with separate exhaust ports and separated by curtain walls all fired top and bottom through the side walls. Each of the three zones is provided with a 16,200 cfm fan for combustion air. In the charging zone, there are 10 burners in the bottom and 8 in the top; the center zone has 14 burners in the bottom and 10 above; and the discharge zone has 6 burners below and 14 above, as well as 8 more across the top of the discharge end wall.

There are essentially seven control zones on this furnace, each with automatic control of temperature, fuel input, and fuel-air ratio. Three furnace pressure controls are also provided. Instruments also record fuel input, fuel-air ratio and furnace pressure.

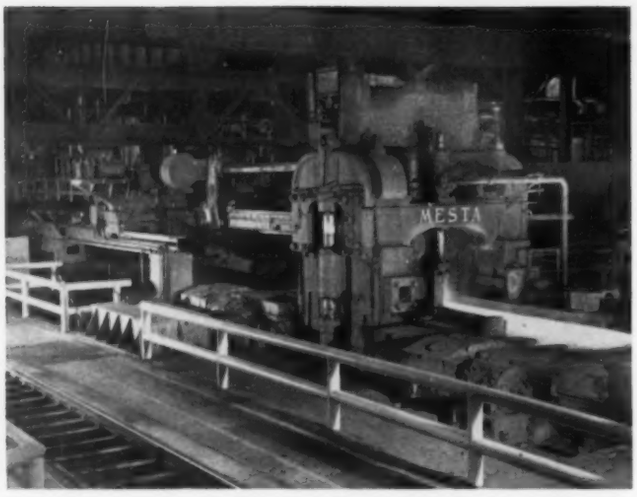
This furnace will heat 75 tons per hr of stainless slabs, or 100 tons per hr of other grades.

After a heated slab is ejected from the heating furnaces through action of the furnace pushers, it is carried on tables to the hot strip mill, the first unit of which is a two-high scalebreaker, followed by a universal two-high reversing roughing stand, a finishing scalebreaker and a continuous finishing train composed of six four-high stands. Table II gives detailed information on the various stands and drives.

The motor driving the edging rolls is located on top of the universal roughing stand.

The twin drives used on the first and second finishing stands resulted from the use of existing motors from the old mill. The roughing scalebreaker stand was the blooming mill of the old mill set-up.

Power for the reversing rougher drive comes from a motor-generator set consisting of two 3000-kw, 625-volt, d-c generators driven by an 8250-hp, 6600-volt, 360-rpm synchronous motor. This set formerly furnished power to the finishing train of the old mill. Another unit, driven by a 1250-hp, 6600-volt, 1200-rpm synchronous motor, contains two 250-kw 300-volt d-c



This 1200-ton hydraulic-electric shear will cut blooms up to 16 in. square and slabs up to 54 in. x 6 in.

generators for the one 150-kw, 250-volt generator for screwdown motors, and one 300-kw, 250-volt generator for roughing mill table motors. The finishing scalebreaker drive receives power from a 400-kw, 600-volt d-c generator which, with four exciters, is driven by a 1250-hp, 6600-volt, 1200-rpm synchronous motor.

The six finishing stands are served by three motor-generator sets, each drive motor being supplied by its individual generator. One set, driven at 514 rpm by a 9000-hp, 6600-volt synchronous motor, carries two 1-600-kw, 600-volt generators for No. 1 finishing stand and two more for No. 2 stand. Stands No. 3, 4 and 5 are supplied from three 3500-kw, 600-volt generators driven by a 15,000-hp 6600-volt, 360-rpm synchronous motor while No. 6 stand is served by a 2400-kw generator driven by a 3400-hp, 514-rpm synchronous motor.

The use of individual generators for each mill drive motor results in faster response to the adjustable voltage control, thus reducing the chances of cobbles during mill schedule changes.

The mill has no turntables, slab pusher or slab squeezer, as no broadside rolling is performed. Slabs from the blooming mill are available in the maximum width that can be handled on the strip mill.

Details of mill table construction and control are given in Table III. The individual table roller motors receive power from two 250-kw, 250-volt d-c generators which, with two 250-kw generators and a 100-kw unit serving coilers and pinch rolls, are driven by a 1250-hp, 6600-volt, 1200-rpm synchronous motor.

Provision has been made in the construction of the relay table for the installation of a lift-off and transfer, so that universal plate can be rolled if desired.

Between each two finishing stands is a looper, actuated by torque motors through worm gearing. A special 30-kw, 75-volt motor-generator set serves the looper motors, which are started and stopped automatically by load relays on the mill stands, or manually from the speed pulpit.

In the reversing rougher, edger and both scalebreakers mill rolls are of cast steel. In the finishing train, work rolls are of cast iron and back-up rolls of cast steel. Roll neck bearings are of babbitt on No. 1 scalebreaker, bronze on the edger, oil film on the reversing rougher, and fabric on No. 2 scalebreaker, with the four-high finishers having roller bearings on the work rolls and oil film on the back-up rolls.

All pinion stands are equipped with babbitt bearings except on No. 2 scalebreaker, which has roller bearings. Babbitt bearings have been applied to the reduction gears on No. 1 scalebreaker, and No. 1 and 2 finishing stands. The gear sets on the vertical edger and No. 2 scalebreaker are equipped with roller bearings.

Wherever two screwdown motors are applied to one stand, they are joined by magnetic clutches, permitting operating of the screws separately or in unison. Just preceding the finishing train is a rotary flying crop shear for cropping front or tail ends of the strip. It is driven by a 75-hp, 230-volt shunt motor, and controlled from the pulpit. Immediately following the last finishing stand is another flying shear with two top heads giving any desired cut length up to 33 ft. This shear is driven by a 900-hp, 600-volt, 300-rpm d-c shunt motor, controlled by synchronization with either No. 5 or No. 6 finishing station. The motor receives power from a 750-kw, 600-volt generator driven by an 1100-hp 6600-volt, 900-rpm synchronous motor.

As the strip passes through the mill, scale is removed by a single set of water sprays at No. 1 scalebreaker, and a double set at No. 2 scalebreaker. The sprays are controlled by solenoid operated air valves. Water comes from two vertical plunger pumps rated at 560-gpm, 1200-psi pressure, each driven by a 450-hp, 2200-volt induction motor. Water usage averages about 300 gal per ton of steel rolled.

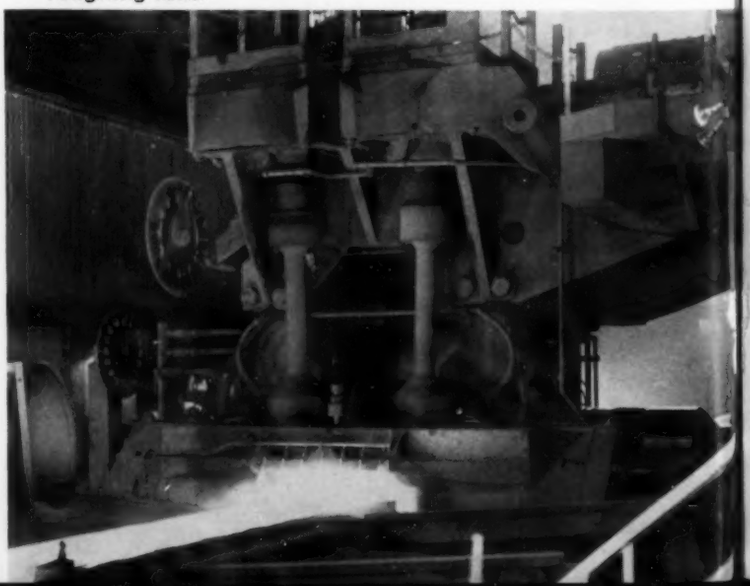
At the reversing rougher, steam jet blowers are also installed for scale removal.

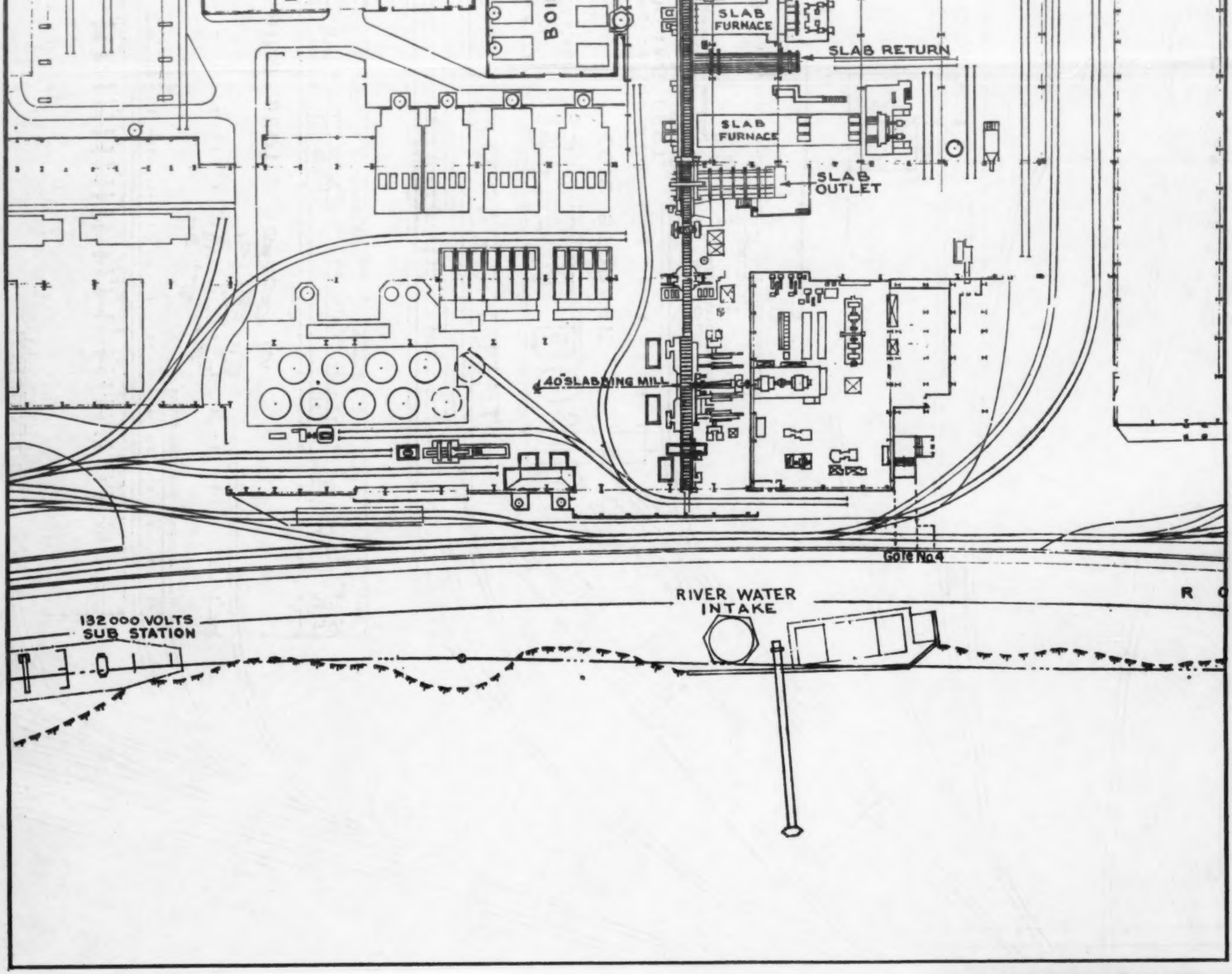
Located some 192 ft beyond the end of the finishing train are two down-coilers with the mandrels driven by 200-hp , 230-volt shunt motors, and with motor-driven pinch rolls and guide rolls. Coils can be formed ranging up to 550 lb per inch of width, which is larger than most of the hot strip coilers now in operation.

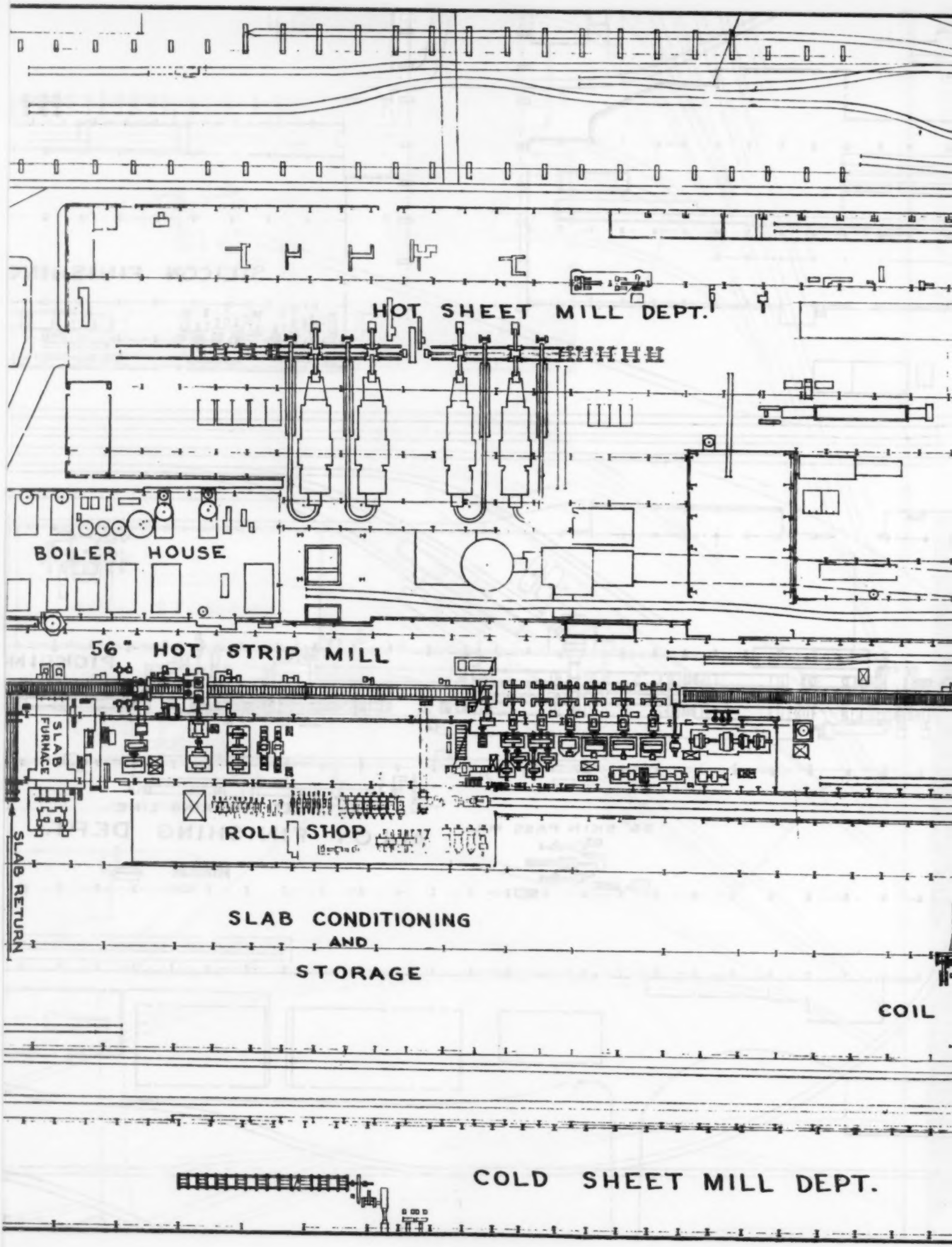
Temperature of the steel is watched carefully during the rolling process. Radiation pyrometers are installed after the roughing stand, just ahead of the crop shear, after the last finishing stand, and at the coilers.

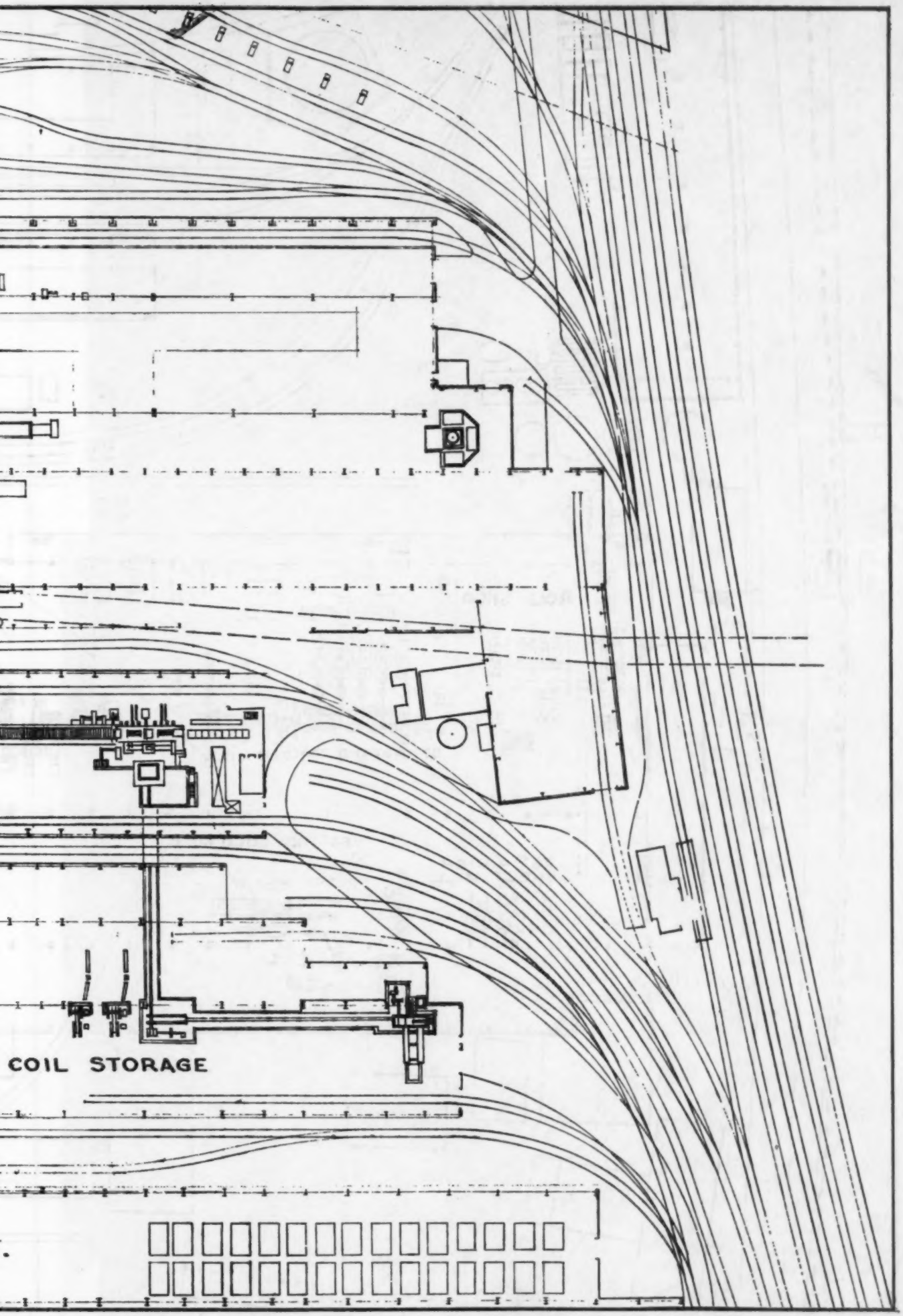
A thickness gage is installed at the delivery side of the last finishing stand. A portable width gage is also

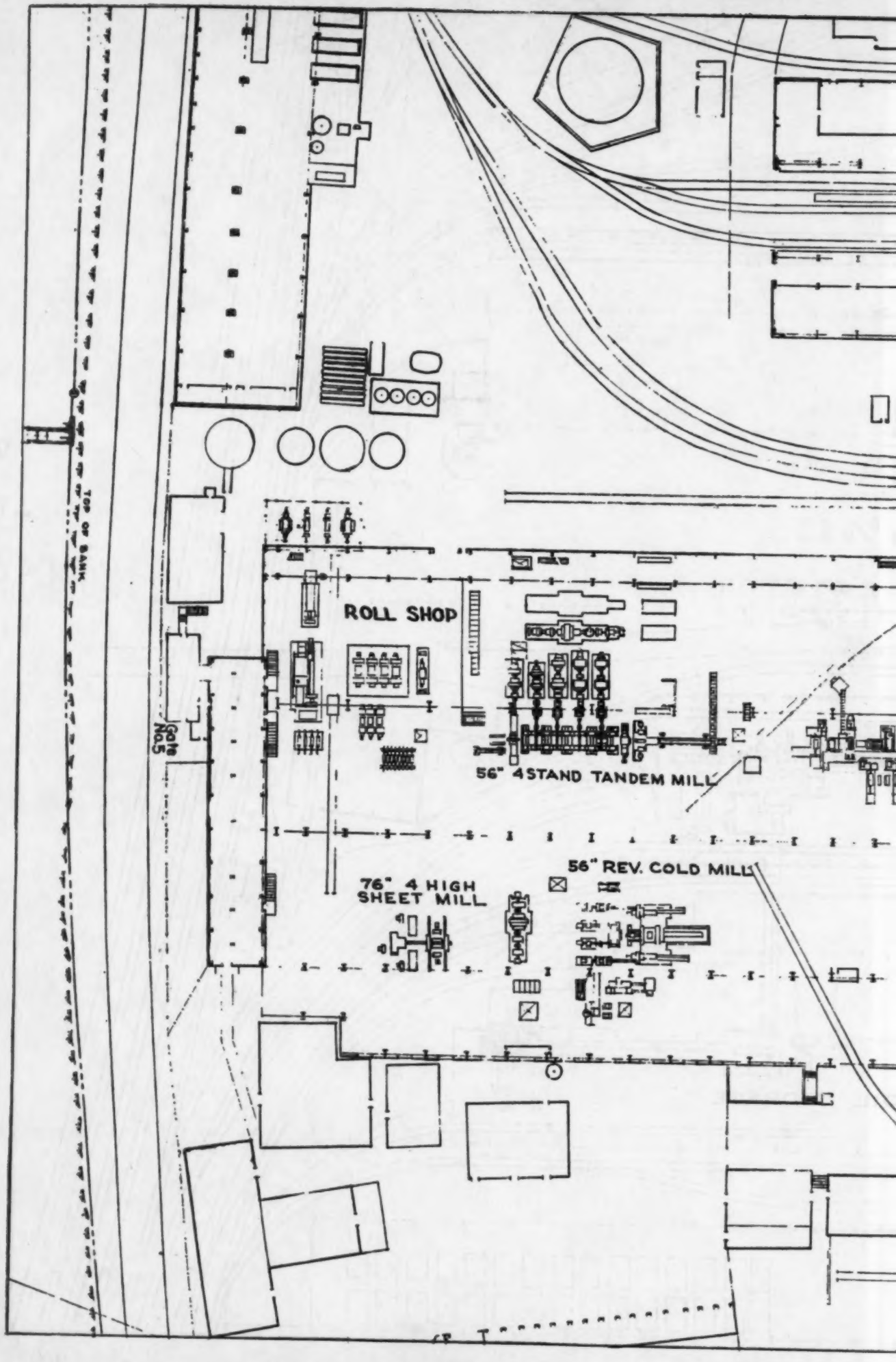
The two-high universal reversing rougher is driven by a 6000-hp motor, with a 250-hp motor on the integral roughing rolls.

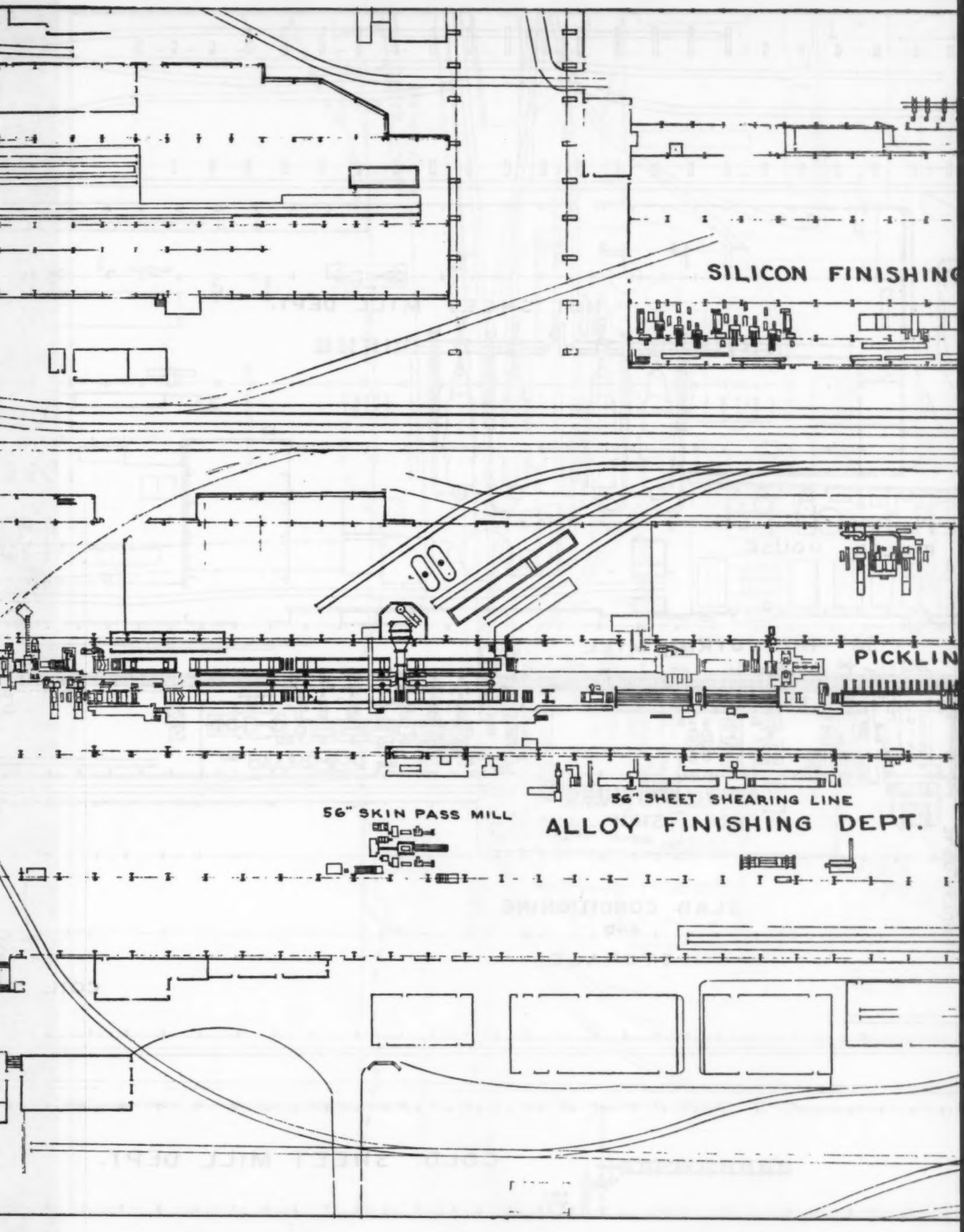



SLAB FURNACE
SLAB RETURN
SLAB FURNACE
SLAB OUTLET
40" SLABBING MILL
Gate No.4
RIVER WATER INTAKE
132 000 VOLTS SUB STATION


HOT SHEET MILL DEPT.
BOILER HOUSE
56" HOT STRIP MILL
SLAB FURNACE
ROLL SHOP
SLAB RETURN
SLAB CONDITIONING
AND
STORAGE
COIL
COLD SHEET MILL DEPT.


COIL STORAGE


ROLL SHOP
56" 4 STAND TANDEM MILL
56" REV. COLD MILL
76" 4 HIGH SHEET MILL
No 5


SILICON FINISHING
PICKLIN
56" SHEET SHEARING LINE
56" SKIN PASS MILL
ALLOY FINISHING DEPT.

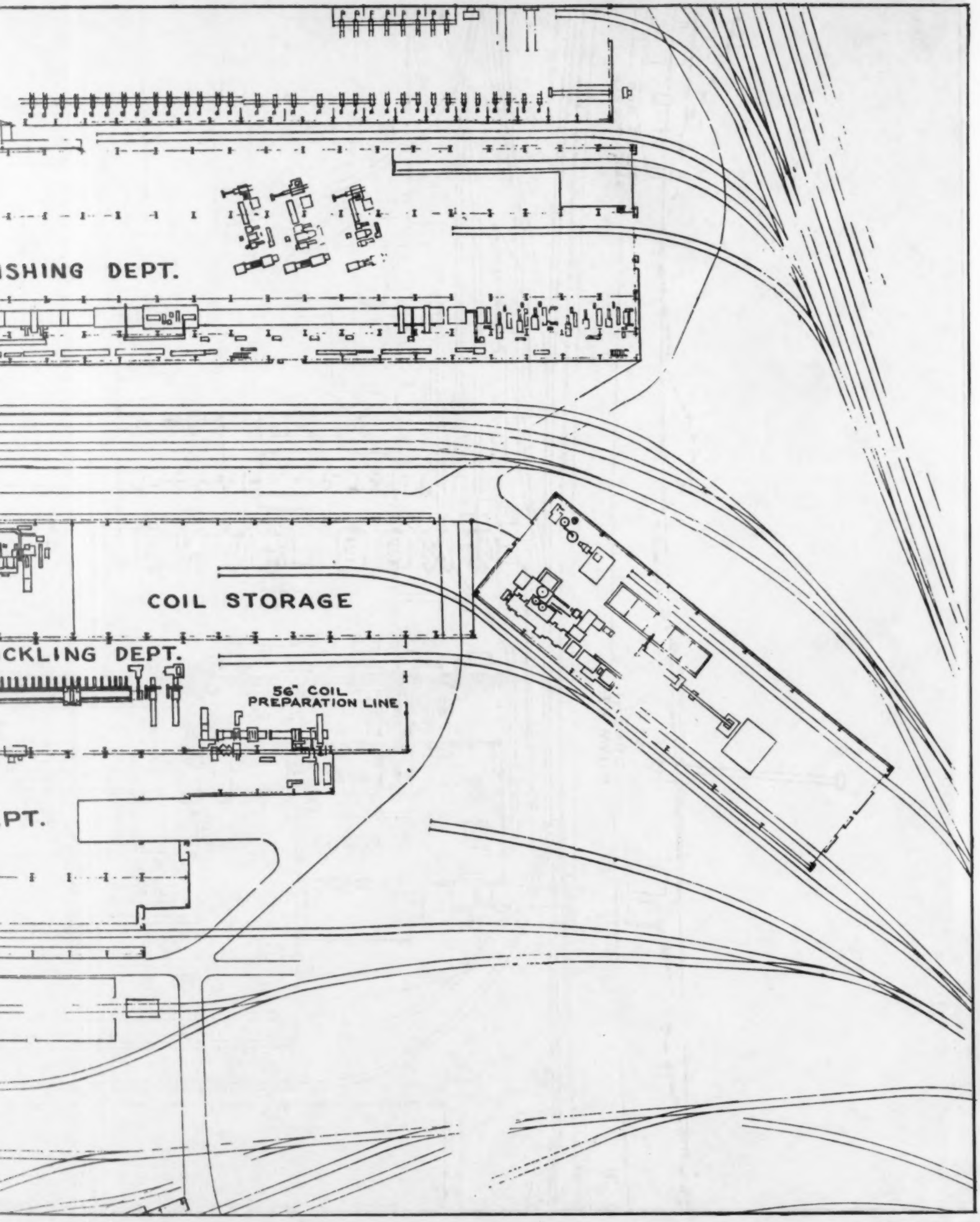

SHING DEPT.
COIL STORAGE
CKLING DEPT.
56" COIL
PREPARATION LINE
PT.

TABLE III

Hot Strip Mill Tables

Table	Roller diam, in.	Roller spacing, ft-in.	Table length, ft-in.	Drive motors, Number and hp	Control
Furnace discharge	14	2-0	114-0	(3) 50*	Magnetic
Scale breaker approach	14	2-0	34-0	(2) 75**	Adjustable voltage
Rougher rear table	16	2-0	22-0	(2) 75 †	Adjustable voltage
Rougher front table	16	2-0	22-0	(2) 75 †	Adjustable voltage
Rougher run-out	14	2-4	34-8	(2) 75 †	Adjustable voltage
Finisher approach	14	3-0	114-0	(2) 75**	Adjustable voltage
Mill run-out	12 and 18	.....	208-6	(139) 3††	Adjustable voltage

*Arranged for operation with reversing roughing mill. **Two separate drives. †Motors in parallel. ††Individually driven rolls.

provided, which can be used wherever desired to investigate spreading of the strip as a result of rolling procedure.

The hot strip mill is lubricated by six circulating oil systems with full filtration and automatic control of pressure and temperature, and eight automatic and three manual grease systems.

It is worthy of mention that the pulpits for the reversing roughing mill, finishing train speed control and down-coilers are arranged for one man operation.

Main drive motors, gear sets, motor generator sets, control equipment and switch gear for the hot mill are located in a motor room 430 ft long x 44 ft wide extending along the hot mill building. This room is ventilated by a recirculating system, with air being drawn from the room down through the rotating machines

Finishing stands are spaced on 18 ft centers. Each drive motor receives power from its own individual generator, giving faster response to the adjustable voltage control.

and passing through eleven air coolers and back into the motor room. Nineteen fans are installed in the system. Make-up air which runs about 15 per cent, is drawn in through a 100,000-cfm electro-static precipitator.

Adjacent to the motor room is a roll shop where all work rolls are ground. Plans call for expansion of this shop, with additional grinders and lathes so that all hot strip rolls may be taken care of here. At present, some of this work is done on equipment located in the silicon finishing department.

In rolling slabs down to strip, the reduction schedule follows a pattern of relatively light reductions with high rolling speeds in the roughing stand, a practice which improves the strip edges. Reversing mill passes run about 25 per cent reduction on silicon steels and 20 per cent on alloys. In the finishing stands, reductions are about as follows:

Stand	Per cent reduction	
	Silicon steel	Alloys
No. 1	50	40
No. 2	40	33
No. 3	33	25
No. 4	25	16
No. 5	23	14
No. 6	13	7

Approximately 80 per cent of the mill's production is in coil form, 20 per cent in flat lengths. About 95 per cent of the output goes into full finished product.

COLD FINISHING

To clean the hot rolled strip prior to cold reduction, two continuous lines are used. Alloy steels proceed to a combination anneal and pickle line 650 ft long. This unit contains two 45-ft catenary annealing furnaces fired by natural gas through nozzle mixing burners, followed by three 60-ft pickling tanks. The ends of successive coils are joined together by lap welding.

The tanks are of welded steel, lined with rubber and acid resistant brick. Steel tank covers, also rubber lined, are vented by a fan which discharges into a stack. Each tank contains 9000 gals of acid solution, usually sulphuric acid followed by a mixture of nitric and hydrofluoric acids. For straight chromium steels, the solutions are left at atmospheric temperature. For the chromium-nickel types, the first tank is kept at atmospheric temperatures, the second at 165 F and the third at 145 F. The first tank is provided with electrolytic equipment which is used only on the straight chromium alloys.

The line operates in a speed range of 8-80 fpm, and can process about 200 tons per day.

This unit is also used for some intermediate annealing between successive cold reductions on alloy steels.

A second line lying beside the other, is intended principally for silicon steels. It is 510 ft long and contains a shot blasting unit and three pickling tanks duplicating those on the alloy line. The solutions in these tanks range up to 15 per cent sulphuric acid, and are maintained at temperatures of 200 F, 180 F and 160 F, respectively, in the three tanks. The use of shot blasting prior to the acid tanks has been found to speed up the pickling process.

This line operates at 250 fpm and is capable of processing about 30,000 tons per month. It is also used to some extent for the first pickling of straight chromium steels.

To obtain desired magnetic properties in silicon steels, continuous annealing is sometimes required between successive cold reductions as well as after final cold rolling. For both of these purposes a roller hearth furnace, 312 ft long x 9 ft 9 in. wide, is provided. Heated with a combination of natural gas in radiant tubes and electricity, this unit runs at 36-130 fpm. Production ranges 240-360 tons per day. Fuel consumption averages 1140 cu ft of gas and 20.4 kwhr per net ton of product.

Under the expansion plans, the principal cold reduction unit will be a 56-in. tandem mill of four-high stands, now under construction. Details of this mill are given in Table II. Work rolls are of forged steel and run in roller bearings. Back-up rolls, of cast steel, operate in oil film bearings.

All four stands are equipped with direct twin drives, operating under adjustable voltage control. Power is supplied by two motor-generator sets, each consisting of one 1000-kw, two 1600 kw, one 1400-kw and one 400-kw generator, all of 600 volts, d-c, and one 125-kw and one 50-kw generator, both of 250 volts d-c, all driven by a 9000-hp, 6600-volt, 514-rpm synchronous motor. Each mill drive motor, as well as each tension reel motor is normally connected to its individual generator but in case of failure of any individual piece of electrical equipment the mill can be operated on half power.

Inspection of the speed cone of this mill shows a shape quite different from that of conventional mills. The speed ranges of the motors set up more of an hourglass shape rather than the usual funnel shape. This gives greater flexibility in rolling with small overall reductions. It might also be noted that the pay-off reel has unusually high speeds, so that the mill can be used with only No. 3 and 4 stands in operation.

Two coilers are installed, each capable of forming coils weighing up to 550 lb per in. of width.

Silicon steel is cleaned in this continuous line containing a shot blasting unit followed by three pickling tanks

Large rotating electrical machines on the tandem mill are cooled by forced up-draft. There is no recirculation. Cooling air is drawn by fans through glass filters.

The tandem mill roll both silicon steel and alloys in widths of 20-50-in. and thicknesses of 0.014-0.025-in. It will have capacity for about 25,000 tons per month.

The 56-in. four-high reversing cold mill, details of which are given in Table II, is unusual in that it is driven through its back-up rolls instead of through the work rolls. This permits the use of small work rolls, which for some special alloys, are reduced to 8-in. diameter.

As usual for cold mills, work rolls are of forged steel, with cast steel back-up rolls. All roll necks run in roller bearings.

The mill drive and both front and back tension reels have twin motor drives with adjustable voltage control. Power comes from a motor-generator set made up of one 3000-kw, 750-volt generator, two 800-kw, 600-volt generators and one 100-kw, 250-volt exciter, all driven by one 5500-hp, 6600-volt, 360-rpm synchronous motor.

Another unusual feature of this mill is the installation of a roller leveler between the feed reel and the entry tension reel. This is used because of the special products rolled and the high cold reductions sometimes performed.

This unit is used to finish alloy strip in widths of 18-49-½-in. and gages of 0.018-0.230-in. Monthly capacity is about 1500-tons. The mill may also be used for very thin silicon steel in widths beyond those that can be finished at the West Leechburg plant to be discussed later.

Also located in the cold finishing department is a 56-in. two-high skin pass mill for coiled material. Details are shown in Table II. This mill affects reductions of 0.0005-0.002-in. on alloy coils 18-49-½-in. wide. Power is supplied by a motor-generator set composed of four 250-volt d-c generators (one 350-kw, one 75-kw and two 30-kw) driven by a 600-hp, 2300-volt, 1200-rpm induction motor.

This department also houses a 75-in., four-high cold sheet mill used on sheet lengths of alloys rolled in mechanized hand mills.

The cold mill roll shop, under construction near the tandem mill, will contain one 60-in. x 18-ft roll lathe and one 60-in. x 18-ft roll grinder.

Miscellaneous equipment in the cold finishing department includes the following:

One 56-in. coil preparation line, containing pay-off reel, straightener shear, hand welder, side trimmer, inspection table and winding reel; 150-300 fpm; 15 tons per hr.

One 56-in. shearing line, including pay-off reel, two levelers, looper table, pinch rolls, shear, gauger table and piler; 25-100 fpm; 6 tons per hr.

One 48-in. and two 36-in. slitting lines each containing pay-off reel, slitter, leveler, inspection table and winding reel; 200-600 fpm; 6-9 tons per hr each.

One 56-in. strip grinder.

One squaring shear.

One stretcher leveler.

Silicon sheets are given a final anneal in one of 39 portable cover type annealing furnaces 58 in. high, and ranging 128-256-in. in length and 60-72-in. in width. The furnaces are fired with natural gas through high-pressure inspirating burners. Fuel consumption averages 2,580,000 Btu per net ton of sheets annealed.

Furnace charges range from 20 tons in the smallest units to 40 tons in the largest.

Furnace atmosphere is supplied by two 300-cfhr gas cracking machines with drawing units.

These furnaces are also used to anneal straight chrome steel coils from the hot mill prior to pickling and cold reduction.

For the production of sheets wider than can be rolled on the strip mill, and for development work with new alloys, a number of hand mills have been retained. Four mechanized pack mills, 40-in., 44-in., 48-in. and 56-in. respectively, are used on silicon sheets. These mills are provided with 60-in. x 60-ft continuous pack furnaces, fired with natural gas. For alloy sheets there is one 78-in. rougher and one 40-82-in. finisher, served by five 90-in. x 160-in. heating furnaces fired with natural gas. All of these mills, as well as five cold mill stands, are driven by a 1600-hp induction motor with flywheel reduction gears.

Another train of cold mills, consisting of nine stands ranging 50-78-in. in width is driven by a 1000-hp steam engine.

In addition, there is the four-high 18 and 49-in. x 75-in. sheet mill, previously mentioned, in the cold finishing department. This mill is driven by a 500-hp, 230-volt, 250-750 rpm d-c motor through a gear reduction of 10.44:1, giving a roll speed of 24-72 rpm or 112-336 fpm. This motor draws power from the general d-c supply system.

This department also contains a plunger mast type batch pickler for silicon sheets, a batch still pickler for alloy sheets in which crates are moved from one tank to another by a remotely controlled crane, and a 90-in. x 150-ft gas-fired normalizing furnace.

Of historical interest is an early tandem mill located in this department, consisting of four 50-in., four-high stands driven by four 250-hp, 400/1200-rpm d-c motors, giving a roll speed of 20-60 rpm. When this mill was in use, alloy sheets would pass through the four stands with a total reduction of only 0.002-0.003-in.

TABLE IV

Building and Crane Data

Building	Length, ft	Width, ft	Cranes			
			No.	Capacity, tons		Span, ft-in.
				Main hoist	Aux hoist	
Hot Strip Mill Department						
Mill aisle	560	55	1	25	10	50-0
			1	60	20	50-0
Slab charging	170	53	1	50	10	47-9
	105	55	1	30	5	49-4
Strip coiling	220	98	1	35	10	92-0
			1	15	....	92-0
Shipping	270	68	1	15	5	61-6
Roll shops	235	55	1	30	10	49-4
	100	57	1	50	10	52-0
Slab grinding	630	68	1	20	....	61-6
			1	20	....	61-6
Motor room	430	44	1	75	....	38-0
Cinder pit	62	43	1	15	....	38-0
Strip Finishing Department						
Grinding	190	77	1	15	5	71-8
Anneal and pickle—						
Weld and inspect	775	74	1	15	....	68-6
Rev. cold mill	1020	82	1	7½	....	76-8
Skin pass,			1	15		76-8
Cut-to-length,			1	30	5	76-8
Shipping			1	20		76-8
Shipping	940	52	1	5		46-10
	....	....	1	5	....	46-10
Tandem cold mill—						
Mill aisle	380	74	1	60	20	68-6
Motor room	380	77	1	60	20	71-8
Silicon Normalizing Department						
Normalizing	580	40	....	....	....	....
Slit and level	580	57	1	7½	....	52-0
	....	....	1	20	15	52-0
Shipping	580	44	1	15	....	38-8

PLATE MILL

Rolling facilities at Brackenridge also include a 110-in. sheared plate mill which is used only for the production of high alloy plate. Slabs for this mill range 3-6-in. in thickness and 24-40-in. in width, with length determined by the desired weight. Maximum weight is 3000 lb. The slabs are cut to the desired size by a powder metal torch.

Slabs are moved to the furnace by transfer car, and are handled into and out of the furnaces by stiff leg charging cranes. They are first placed in a two-door preheating furnace fired with natural gas or fuel oil.

After this preliminary heating, slabs are transferred to a six-door batch type furnace burning either gas or oil. The furnace is 43 ft long x 7 ft 4-in. wide x 6 ft high.

The mill itself is a three-high unit with roll diameters of 32-in. on top and bottom, and 20-in. in the middle. It is driven at 65 rpm by a 30-in. x 60-in. steam engine rated at 2200-hp. A 30-ft tilting table is installed on each side of the mill. Stainless steel plate is regularly rolled up to 72-in. wide and occasionally, 80-in.

Auxiliary equipment in this department includes three annealing furnaces with water quench tanks a 108-in. hot roller leveler, a 108-in. cold roller leveler, two large resquaring shears, an abrasive cut-off machine, a circle shear, and a sand-blasting chamber.

MISCELLANEOUS DEPARTMENTS

An important department of the Brackenridge plant, and an unusual one insofar as steel plants are con-

This 56-in. four-high reversing cold mill is driven through its back-up rolls, thus permitting the use of 8-in. work rolls for special alloys.

cerned, is the lamination department. Here is an army of presses, devoted entirely to making electrical motor and transformer laminations and stampings in a multitude of shapes and sizes. Also provided are many heat treating furnaces and a complete tool room for die production. Much of the equipment in this department has been modernized in the post-war expansion program.

As might be expected from its pioneering in specialty steels, Allegheny Ludlum carries on extensive research. Overlooking the Brackenridge plant is a new, well equipped research center devoted principally to work on stainless and electrical steels. Much experimental work is also performed in the plants in the search for new products, new methods, greater economy and higher quality.

Electric power for the Brackenridge plant is purchased, reduced from 132,000 volts to 25,000 volts in four 30,000-kva transformer banks and enters the plant through four principal substations. No. 1 Substation contains six 5000-kva, 25,000/6600-volt single phase units supplying the hot strip mill, three 2500-kva, 25,000/6600-volt single phase units serving the 40-in. blooming mill and the 56-in. reversing cold mill, three 2500-kva, 25,000/2300-volt, single phase transformers for the hot strip mill, six 667-kva 25,000/440-volt, single phase units for hot strip mill auxiliaries, and three 2000-kva, 25,000/440/220-volt, three-phase units serving the silicon finishing department.

At No. 2 substation, two 10,000-kva, 25,000/6600-volt, three-phase transformers supply the four-stand tandem cold mill and three 2500-kva, 25,000/2300-volt, single phase units serve a number of miscellaneous departments.

The old and the new electric furnaces are supplied with power from two other centers, with the 25,000-volt power going to the transformers given in the table of arc furnaces.

Overall demand of the Brackenridge plant is about 80,000-kva, with monthly consumption running about 30,000,000 kwhr per month.

A small amount of a-c power may be generated by one 1000-kw and one 1500-kw turbo-generator. Additional d-c power is generated by four motor-generator sets.

Steam for engine drives, turbines, processing and heating is generated at 148-psi pressure, 350-F superheat in ten boilers totaling 240,000 lb pr hr. The boilers are fired with pulverized coal, with natural gas or fuel oil as stand-by.

Plant water comes directly from the Allegheny River through strainers pumped by five 6400-gpm centrifugal pumps. For special purposes, water is purchased from the city system.

WEST LEECHBURG

The West Leechburg plant occupies a 49-acre site and has some 2400 employees. It produces no steel, but contains only strip rolling and finishing equipment, much of which was recently installed in an overall rebuilding and expansion program which more than doubled the finishing capacity for alloy products and quadrupled that for silicon steels.

Hot rolling facilities consist of two continuous hot strip mills, installed in 1922 and 1930. Details of both of these mills are given in Table V.

The 16-in. mill reduces 3-in. slabs, 10 ft long and 6-20-in. wide to strip 6-20-in. wide and averaging 0.14-in. in thickness. Rolling averages about 25 tons per hr.

Slabs are heated in two 40 ft 1-in. x 12 ft 9-in. hearth continuous furnace, top-fired with natural gas or fuel oil through ten long flame combination burners.

All roughing stands except No. 5 and 7 are equipped with bronze roll neck bearings, with compensation bearings in No. 5 and 7 roughers, and in all finishing stands.

All roughers except No. 6 edger are driven through gears and line shaft by a single 2200-hp, 2300-volt a-c motor. The first two finishers are driven by one 1500-hp, 2300-volt, a-c motor. The last four finishing stands are individually driven by 240-volt d-c motors receiving power from two 2000-kw and one 1000-kw motor generator sets. Motors driving the runout table draw power from a 50-kw generator driven by a belt from the last finishing stand.

Steel leaves the mill at speeds up to 1560 fpm and proceeds over the runout table to a coiler, or, for

A wide variety of laminations and stampings for motors and transformers are produced at the Brackenridge plant.

straight lengths, over a cooling bed on either side of the runout to cold run tables.

The 12-in. mill reduces 3-in. slabs 20-ft long and 6-10-in. wide to strip 2¾-10-in. wide and averaging 0.095-in. in thickness. The mill rolls at a rate of approximately 24 tons per hr. Normally, only carbon steel is rolled on the 12-in. mill, for the most part from slabs purchased on the outside.

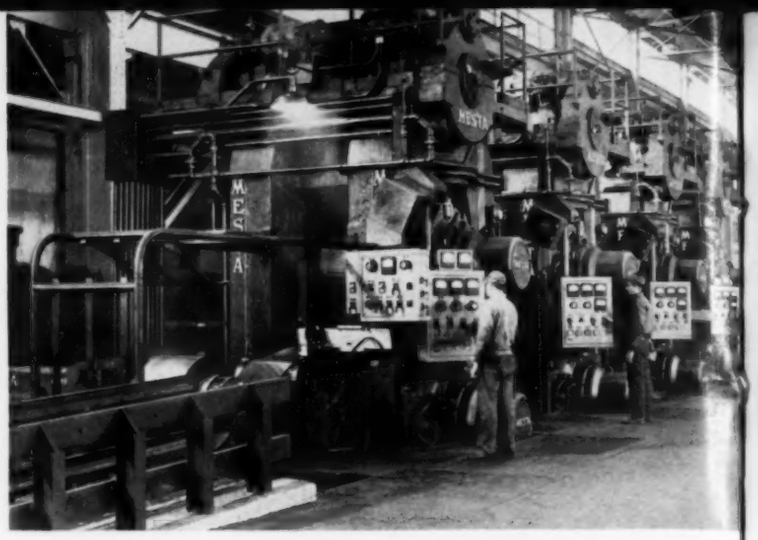
Heating facilities on the 12-in. mill consist of one side-charge, side-discharge continuous recuperative furnace with a hearth 30-ft 4½-in. long x 21 ft 6-in. wide. The furnace burns natural gas or fuel oil in 14 burners spaced across the discharge end wall.

All roll necks of the 12-in. mill run in composition bearings except the three edgers, which have bronze bearings. These edgers are driven by 100-hp, d-c motors, while a single 1600-hp, 2200-volt, a-c motor drives the other roughing stands through line shafts and gearing.

Finishing stands are individually driven by 800-hp, 240-volt, d-c motors which are provided with power by two motor-generator sets, one of 2000-kw and one of 1000-kw.

Material leaving the 12-in. mill at speeds up to 2160 fpm passes through oscillating guides, forming the so-called "Christmas candy" shape on the apron conveyors from which it is removed by a vertical coiler.

In both mills, a repeater is installed between the roughing stands and the finishing train, reversing the direction of rolling. The 16-in. mill also has a transfer which may be used instead of the repeater.



This 29-in. tandem cold mill is used principally for roughing down silicon and alloy steels and for finishing some silicon steels.

On both mills, descaling sprays are placed at the entry of stands Nos. 3, 6 and 9. Spray valves are operated by electric thrusters. Water for both systems comes from one plunger type pump rated at 700-gpm, 750-psi pressure.

Hot rolled material is cleaned in three pickling lines. Silicon steel is processed in a unit containing a shot-blasting machine, followed by a 44-ft, 5400-gal tank

TABLE V

Hot Strip Mills — West Leechburg Plant

Stand	Roll dimensions		Distance from preceding stand, ft-in.	Motor data				Roll, rpm	Strip speed, fpm
	Body length, in.	Diameter, in.		Hp	Voltage	Type	Rpm		
16-in. Hot strip mill									
No. 1 Edger	24	20¼	.....					35	180
No. 2 Rougher	30	20	15-0					35	175
No. 3 Rougher	30	20	12-10	2200	2200	induction	713	51	270
No. 4 Edger	26	13	28-3					96.2	500
No. 5 Rougher	30	20	25-10½					73.8	385
No. 6 Edger	24	15	30-0	(100)	230	d-c	400/800		150/350
No. 7 Rougher	30	20	8-0					96.4	595
No. 8 Finisher	26	17	(Repeater)	1500	2200	induction	705	.....	640
No. 9 Finisher	26	17	50-0						640
No. 10 Finisher	26	17	46-11½	1500	240	d-c	125/250	125/250	558/1116
No. 11 Finisher	26	17	18-0	1500	240	d-c	125/250	125/250	558/1116
No. 12 Finisher	26	17	18-0	1800	240	d-c	185/350	165/350	735/1560
No. 13 Finisher	26	17	18-0	1800	240	d-c	185/350	165/350	735/1560
12-in. Hot strip mill									
No. 1 Rougher	18	16	.....					8.65	36
No. 2 Edger	13	21	5-6	(100)	230	d-c	400/800		
No. 3 Rougher	18	16	6-6	1600	2200	induction	705	14.0	59
No. 4 Rougher	18	14	8-6					26.86	98
No. 5 Edger	13	21	5-6	(100)	230	d-c	400/800		
No. 6 Rougher	18	14	6-6					42.01	154
No. 7 Rougher	18	14	7-4					61.68	226
No. 8 Edger	13	21	5-6	(100)	230	d-c	400/800		
No. 9 Rougher	18	14	6-6					97.23	356
No. 10 Finisher	16	12	(Repeater)	800	240	d-c	275/688	75/188	235/590
No. 11 Finisher	16	12	13-0	800	240	d-c	275/688	110/275	345/863
No. 12 Finisher	16	12	10-0	800	240	d-c	275/688	150/375	471/1178
No. 13 Finisher	16	12	10-0	800	240	d-c	275/688	275/688	863/2160
No. 14 Finisher	16	12	10-0	800	240	d-c	275/688	275/688	863/2160

containing an 18-20 per cent sulphuric acid solution at a temperature of 190 F. The line operates in a speed range of 15-175 fpm.

Alloys are cleaned in a line containing a shot-blasting machine and two 44-ft, 5400-gal acid tanks. The first tank contains an 18-20 per cent sulphuric acid solution, while the second contains about 10 per cent of a mixture of nitric and hydrofluoric acids. Speed of the line is 10-128 fpm.

The third line, a multiple strip line, which serves the 12-in. mill, contains two 51 ft 8-in., 4500-gal tanks. A 15-19 per cent solution of sulphuric acid at 190 F is used in both tanks. Line speed is 10-60 fpm.

In all three pickling lines, coils are joined together by riveting, with an electric spot welder also installed on the 12-in. pickling line.

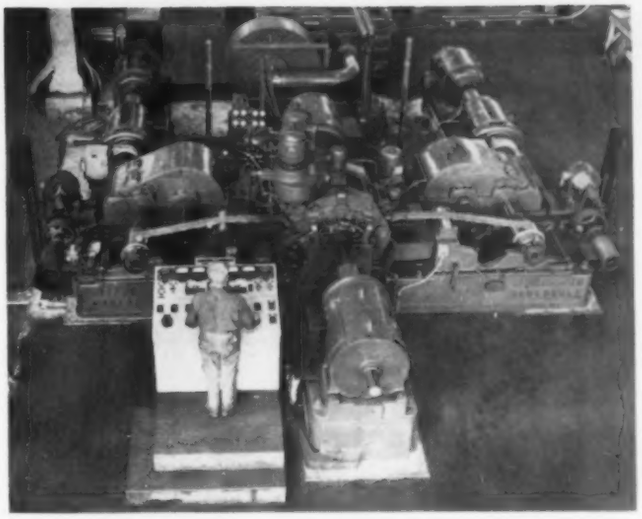
Cold rolling facilities at West Leechburg consist of one 29-in. four-stand, four high tandem mill, one 26-in., four-stand, two-high tandem mill, 13 four-high reversing mills, one cluster type reversing mill, and 10 two-high single stand mills. Details of these mills are given in Table VI.

The 29-in., four-high tandem mill is used principally for roughing down silicon and alloy steels and for finishing silicon steel. The two-high tandem mill roughs alloy and carbon steels. Some single stand reversing units are used for both roughing and finishing, some for finishing only.

These mills provide a total capacity for cold reducing and finishing 128,000 net tons per year of silicon, stainless and special carbon steels. The various mills are set up for particular gages and widths, and to considerable extent, for particular purposes. Overall, these mills handle strip in widths of $\frac{3}{8}$-38 in. and in gages of 0.001-0.200-in. As might be expected, rolling rates vary widely with the type and weight of the product. Monthly production of the various units ranges from 50 tons per month up to more than 10,000 tons per month.

Ten roll grinders and two roll lathes are required to condition the rolls used in the various West Leechburg mills.

The nature of the products and the special properties required in them necessitate extensive intermediate annealing between successive cold rollings. These processes are carried out on eight combination anneal-pickle units, all starting with a catenary annealing furnace, but varying otherwise in layout. Overall length of the lines ranges 130-430-ft. Individual tanks run 15-43-ft in length. Two of the lines have three pickling tanks, six have two. Of the two-tank lines two have electrolytic equipment on both tanks, three have electrolytic equipment on No. 1 tank only. Electrolytic action is used only in sulphuric acid solutions.



This cluster mill is used for special work, particularly the production of very thin material.

The various two-tank units may have a 4-6 per cent sulphuric acid solution in both tanks, a 16 per cent mixture of nitric and hydrofluoric acids in both, or 4-6 per cent sulphuric solution in the first and 16 per cent of the mixture in the second.

The three-tank units use a caustic salt at 900 F in the first tank, 8-10 per cent sulphuric solution in the second, and a 16 per cent solution of nitric and hydrofluoric acids in the third.

Solution temperatures range from 100-180 F. Temperatures as well as solutions are varied, depending on the product to be cleaned and the finish desired. The nitric-hydrofluoric mixture is used on all alloys except where a high finish is desired.

The anneal-pickle lines will accommodate maximum strip widths of 20-38 in., or multiple strands of narrower material.

Four gas-fired catenary normalizing furnaces 67-74 ft long and incorporating a 30-ft furnace and a 30-ft cooling zone are also used for the intermediate annealing of silicon steel. Two are heated by radiant tubes and two are of open-fired muffle design. Strip speed through the furnaces ranges 4-22 fpm.

Other heat treating equipment includes six electric resistor ribbon bell furnaces, nine gas-fired radiant tube bell furnaces, three gas-fired box type portable cover furnaces, six electrically heated car-bottom elevator furnaces, and four continuous tunnel type box anneal furnaces. Three of the last type are installed in the copper coating department.

Straight annealing, at temperatures ranging between 1250 F and 1650 F, is performed in the gas-fired bell and box type furnaces and in the tunnel furnaces. Gas generators supply prepared atmospheres for these furnaces. High temperature annealing (2000 F and over) for high grade silicon steel is carried on in the electric-

Four-high reversing mills such as shown here are used for intermediate and finish rolling of silicon and alloy steels.

TABLE VI
West Leechburg Cold Mills

Stand	2-high or 4-high	Length of roll body, in.	Diameter of rolls, in.		Motor data				Maximum delivery speed, fpm
			Work rolls	Back-up rolls	Hp	Voltage	Type	Rpm	
Tandem — Stand No. 1	4	29	12½	40	1000	600	d-c	400/800	645
Stand No. 2	4	29	12½	40	1500	600	d-c	300/600	815
Stand No. 3	4	29	12½	40	1500	600	d-c	300/750	1091
Stand No. 4	4	29	12½	40	2000	600	d-c	250/625	1150
Tandem — Stand No. 1	2	26	16½	..	250	230	d-c	400/800	120
Stand No. 2	2	26	16½	..	250	230	d-c	400/800	120
Stand No. 3	2	26	16½	..	250	230	d-c	400/800	120
Stand No. 4	2	26	18½	..	250	230	d-c	400/800	120
Reversing	4	29	12¼	33	800	250	d-c	500/800	750
Reversing	4	42	15½	49	1500	600	d-c	300/600	1350
Reversing (2 units)	4	30	6	35	(2) 750	600	d-c	180/360	1650
Reversing (2 units)	4	8	2¾	20	100	230	d-c	400/1200	1200
Reversing (4 units)	4	20	4	24	200	230	d-c	400/800	1500
Reversing	4	26	5.28	27	500	230	d-c	375/750	1800
Reversing (2 units)	4	25	6	28	1000	600	d-c	250/750	1800
Reversing	Cluster	..	1⅝	..	....	...	....	.....	440
Single stand (2 units)	2	10	8⅛	..	50	230	d-c	400/800	115
Single stand	2	16	12½	..	175	230	d-c	400/800	275
Single stand	2	16	12½	..	80	230	d-c	400/815	240
Single stand (2 units)	2	26	18½	..	250	230	d-c	400/800	105
Single stand (2 units)	2	14	10¼	..	100	230	d-c	400/800	337
Single stand	2	29	18½	..	250	230	d-c	400/800	86
Single stand	2	42	28	..	250	250	d-c	575/1150	300

ally heated bell furnaces and the car-bottom elevator furnaces, with a hydrogen atmosphere.

To carry out the varied finishing operations required by the many specialties, West Leechburg plant also has a host of miscellaneous finishing units, including 15 slitting lines, 6 welding lines 3 slitting and welding lines, 4 cut-to-length lines, 3 punch presses for producing blanks from ¼-in. to 24-in. in diameter, circle shear, edge trimmer, stretcher leveler, grinders, polishers, buffers, etc.

The West Leechburg plant contains 45 overhead cranes, all except two of 15-ton capacity or less.

Electric power for the West Leechburg plant, purchased from the utility company serving the area, enters the plant over two 4/0 lines at 25,000-volts and is carried at that voltage from the main substation to four substations within the plant. One station contains three 1667-kva transformers and three 3333 kva, units, the two banks operating in parallel at 25,000/2300-volts. The second station consists of one bank of three 3333-kva, 25,000/2300-volt transformers. The third station has one bank of three 3333-kva, 25,000/6600-volt transformers, and another of three 667-kva, 25,000/460-volts. The fourth station has one bank of three 1000-kva, 25,000/2300-volt units.

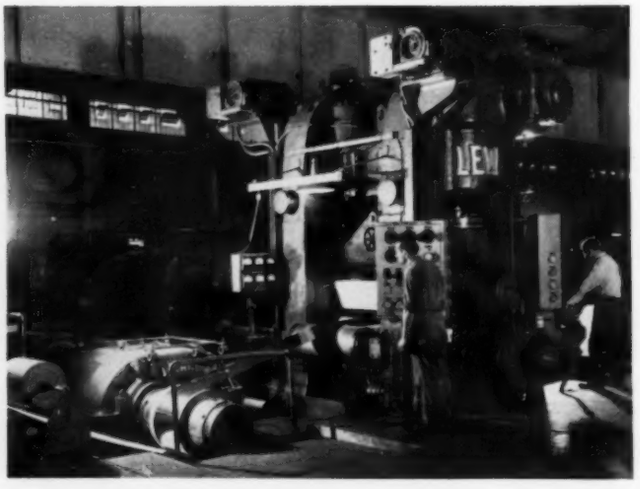
The West Leechburg plant sets up a total power demand of about 15,000-kva.

Steam for various processing lines and for building heating is generated at 150-psi pressure in three coal-fired, bent tube type boilers.

All water is purchased from the water authority serving the area.

Practically all product finished at West Leechburg requires intermediate annealing between successive cold reductions. These furnaces process silicon steels.

Single stand mills such as this are used for a final planishing pass on alloy steels.



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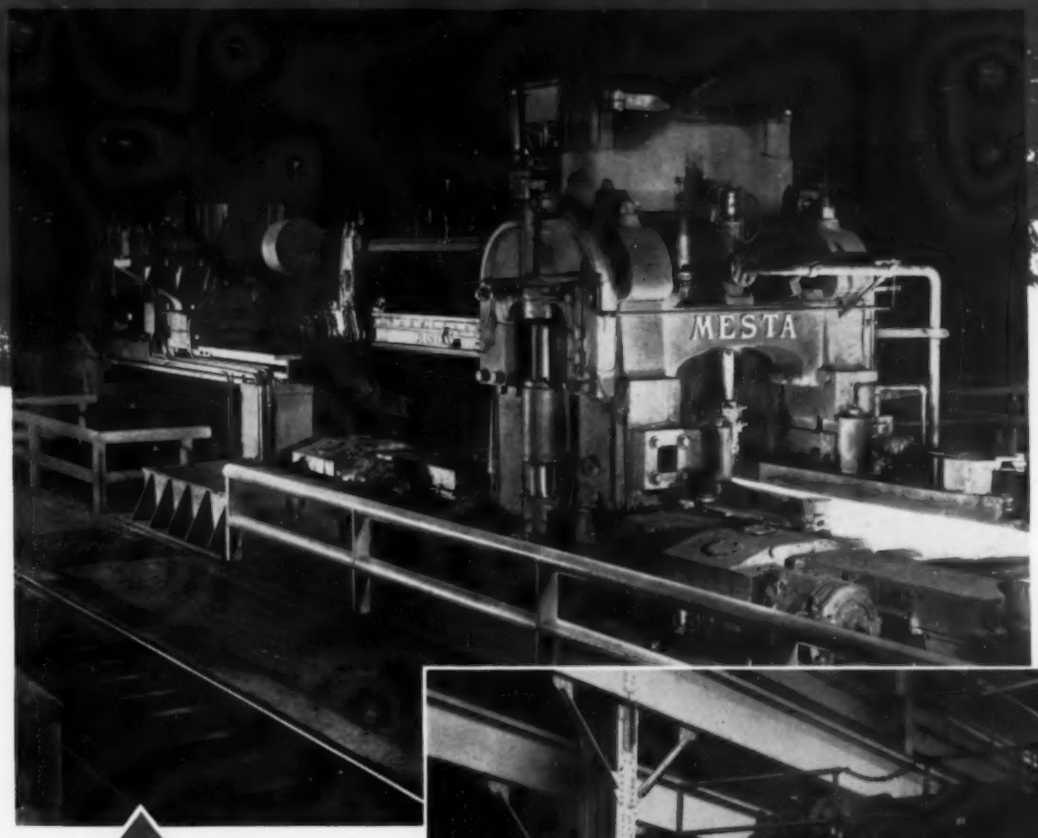

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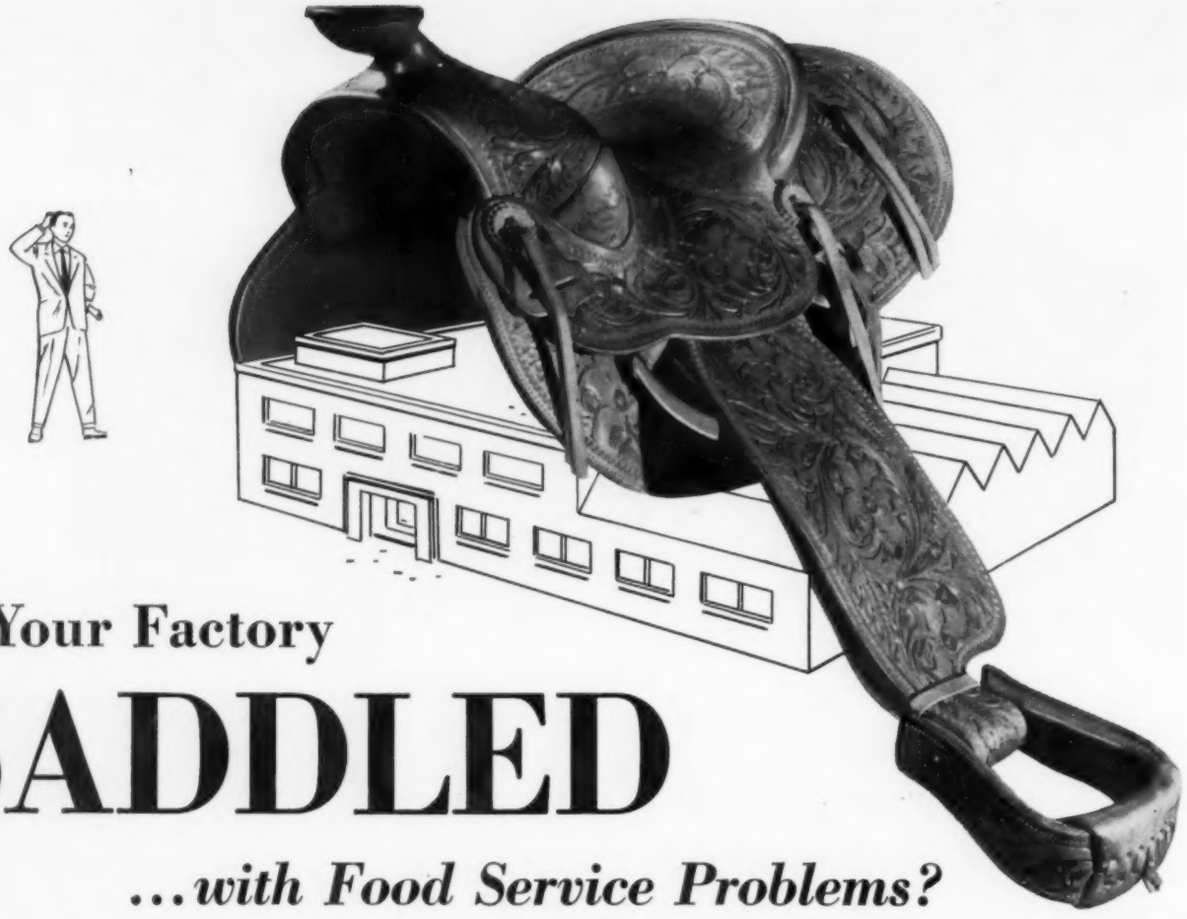

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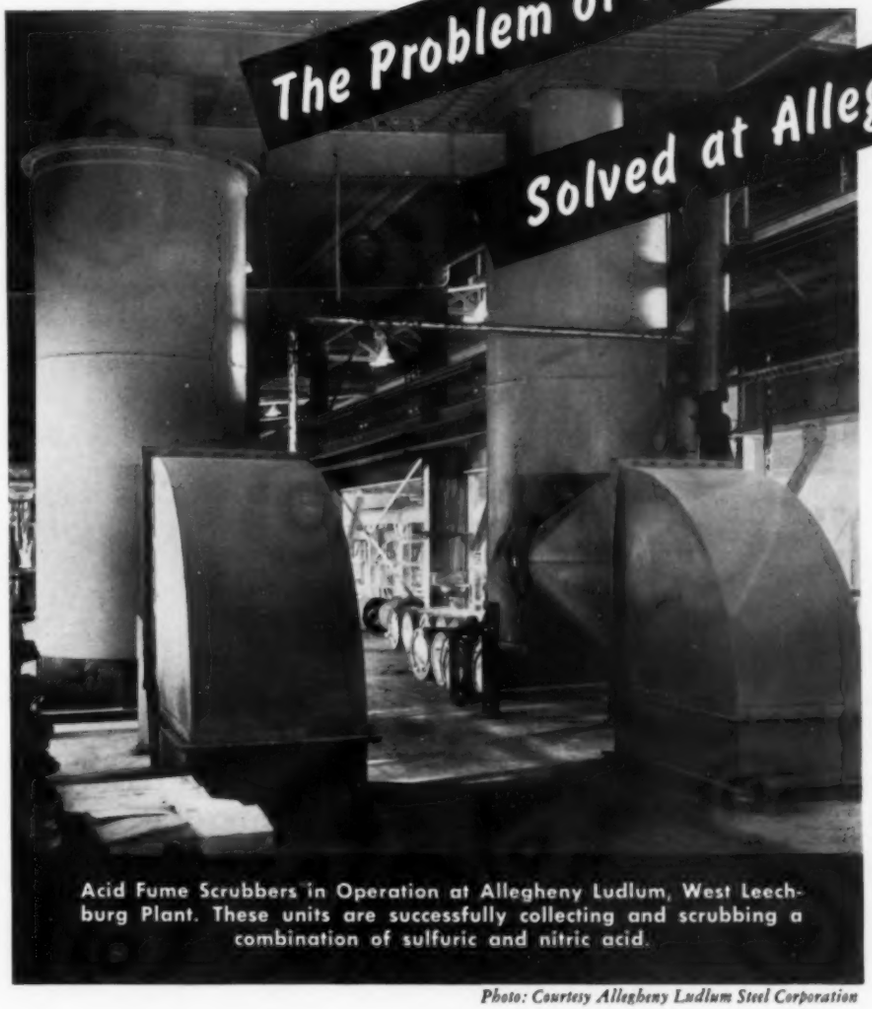

Acid Fume Scrubbers in Operation at Allegheny Ludlum, West Leechburg Plant. These units are successfully collecting and scrubbing a combination of sulfuric and nitric acid.

Photo: Courtesy Allegheny Ludlum Steel Corporation

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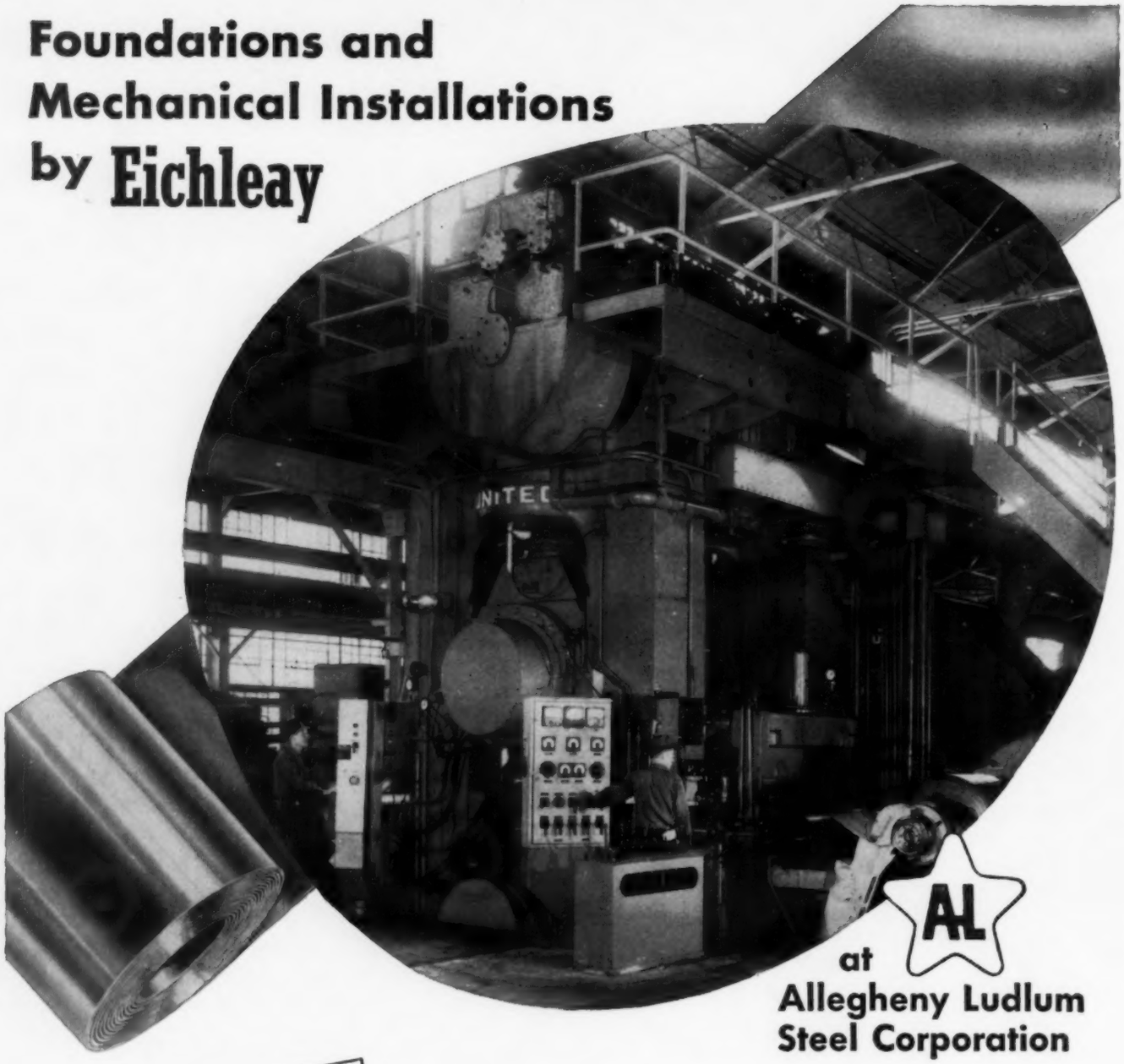

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Pictured above is the 56″ 4-Hi Reversing Cold Mill recently mechanically installed in the plant of the Allegheny Ludlum Steel Corporation. Mechanically installed also was a 56″ Continuous Annealing and Pickling Line.

Other installations, including foundation work, were a 56″ 2-Hi Skin Pass Mill; a 56″ Slitting, Welding and Inspection Line; and a 48″ Cut-to-Length Line.

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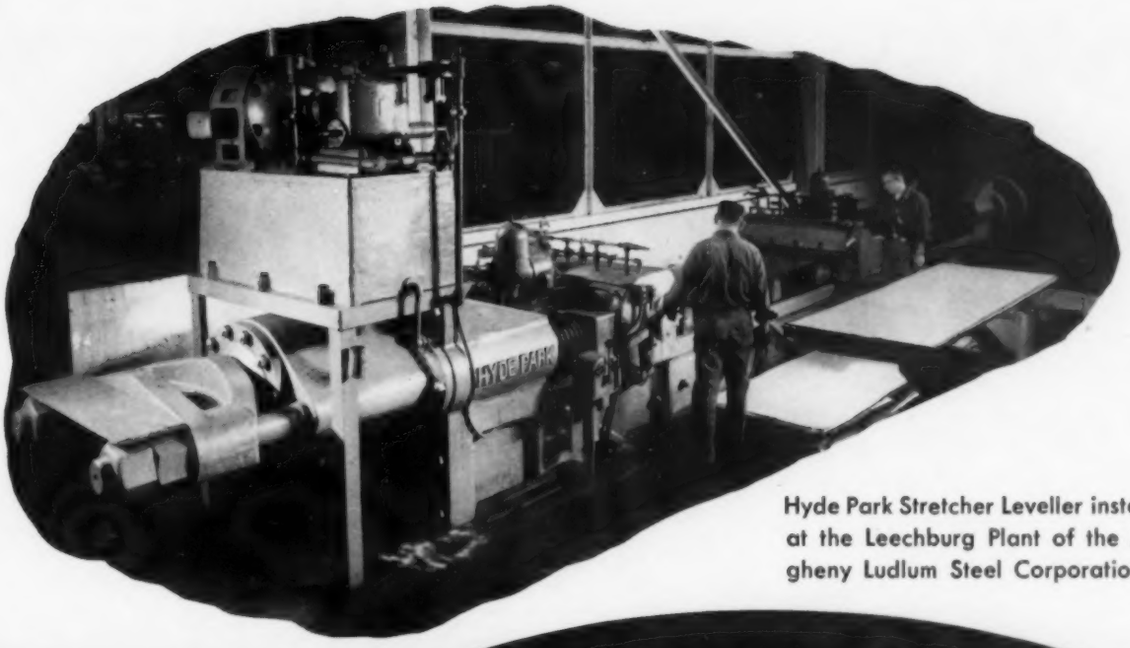

Hyde Park Stretcher Leveller installed at the Leechburg Plant of the Allegheny Ludlum Steel Corporation.

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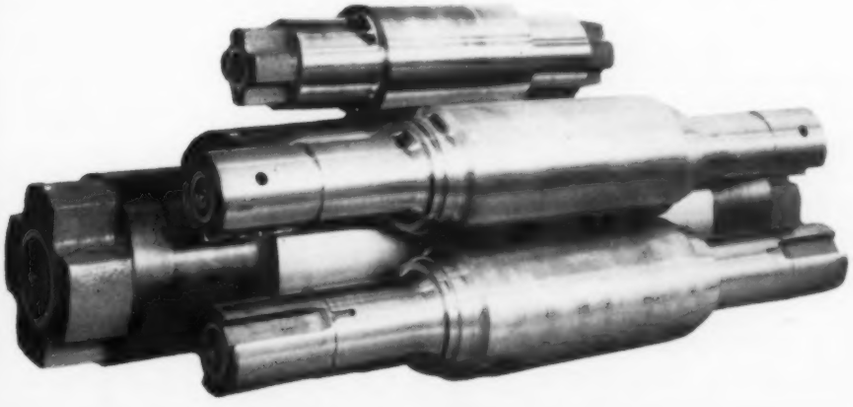

Hyde Park FOUNDRY & MACHINE CO.
HYDE PARK, WESTMORELAND COUNTY, PITTSBURGH DISTRICT, PA.

ALLEGHENY LUDLUM USES OKOLITE-OKOPRENE feeders for 70-ton arc furnaces

Cross section of 35 KV Okolite insulated power cable (¾ actual size) which feeds arc furnaces at Allegheny Ludlum.

At the Brackenridge Plant of the Allegheny Ludlum Steel Corporation, two 70-ton and two 60-ton electric arc furnaces are equipped with Okolite-Okoprene rubber-insulated main power feeders. The cables are installed from overhead power feeders to the transformers and disconnect switches, and operate at 25,000 volts with peaks to 26,000 volts.

These single-conductor 750 MCM rubber-insulated cables with almost an inch (56/64″) Okolite rubber insulation and 8/64″ Okoprene sheath are rated at 35,000 volts, ungrounded. The installation at the Brackenridge Plant is another indication of the trend in industry toward the use of Okolite-Okoprene rubber-insulated cables for high voltage applications.

Okonite's new 128-page manual, Bulletin IS-1075, points out the advantages, versatility and economies obtained by the use of rubber-insulated cable for voltages up to 35,000 volts. Write for your copy to The Okonite Company, Passaic, New Jersey.

OKONITE SINCE 1878 **insulated cables**

2058

FARRELL-CHEEK

HEADQUARTERS for CRANE WHEELS

SALUTES

ALLEGHENY LUDLUM

ON THE EXPANSION OF ITS BRACKENRIDGE AND WEST LEECHBURG, PENNSYLVANIA PLANTS

Farrell-Cheek Steel Company has had the privilege of supplying large quantities of crane wheels for these important additions to the already impressive facilities of a great American company—Allegheny Ludlum Steel Corporation. These wheels have been cast from the best steel alloys with the full benefit of the experience that has made Farrell-Cheek the finest name in cast steel for more than 44 years.

FARRELL-CHEEK STEEL CO.

MANUFACTURERS OF HIGHEST QUALITY ELECTRIC FURNACE CARBON AND ALLOY STEEL CASTINGS

FARRELL'S CARBON STEEL CASTINGS

FARRELL'S HARD EDGE STEEL CASTINGS

FARRELL'S "85" STEEL CASTINGS

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ELEVATOR, CONVEYOR PARTS
Sprockets, Traction Wheels, Chains, Buckets, Rollers, Idlers.

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Carbon and Alloy Steels Machined, Hardened, Ground.

CRANE WHEELS
Overhead, Gantry, Monorail, Ingot Car, Charging Machine.

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"True Tooth" Gears and Pinions, Sheaves and Wheels.

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Light Section Castings

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Feed Screws, Furnace Tools, Flanged Pipe, etc.

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Wire Rope Fittings, Choker Hooks, Bar Benders, Cutters.

YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

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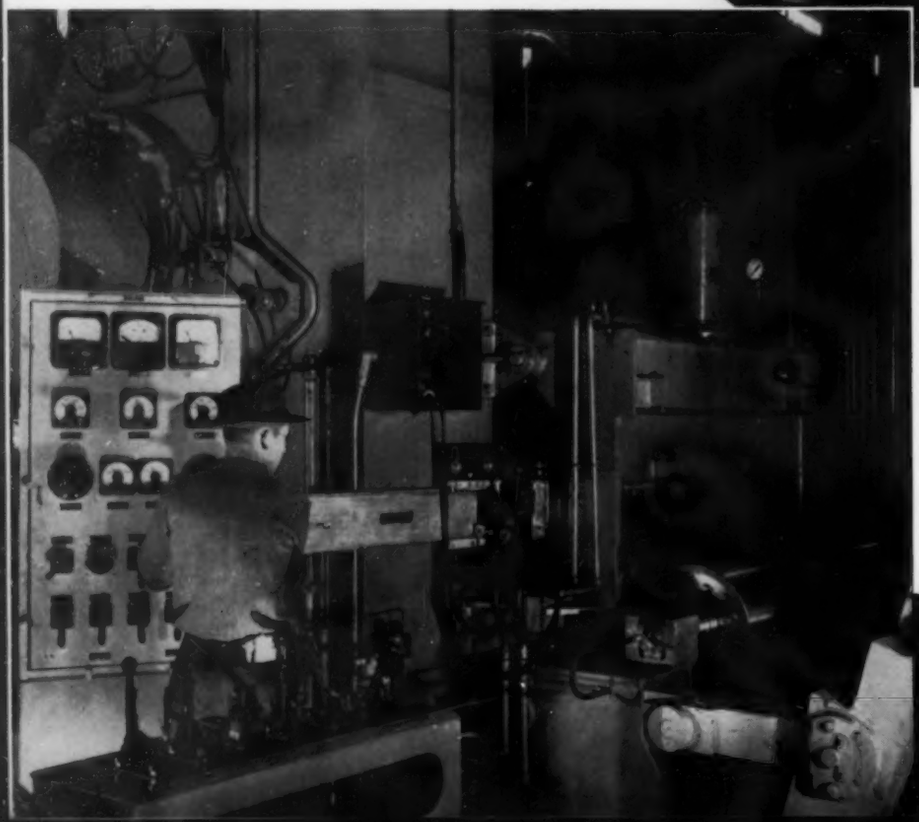
INSTALLATIONS BY

PEC

IN THE IMPROVEMENT PROGRAM OF
ALLEGHENY LUDLUM STEEL CORPORATION
AT BRACKENRIDGE, PA.

ARC FURNACE SHOP

TWO 18 FT. FURNACES
33,000 KVA
LIGHTING - CRANES
DISMANTLED TWO 17 FT. ARC
FURNACES AT HAYS AND
SHIPPED TO BRACKENRIDGE



56" COLD STRIP DEPARTMENT

END WELD & SIDE TRIM LINE
CONTINUOUS ANNEAL & PICKLE LINE
REVERSING COLD STRIP MILL
SKIN PASS MILL
CUT-TO-LENGTH SHEAR LINE

ALL SINGLE RESPONSIBILITY JOBS

FOUNDATIONS
(EXCEPT REVERSING MILL)
MACHINE ERECTION
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PATTERSON-EMERSON-COMSTOCK, IN
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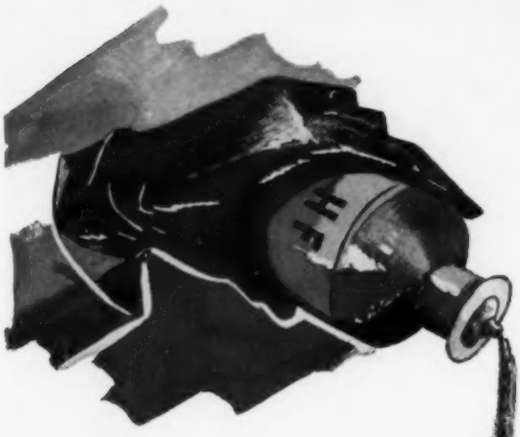
313 EAST CARSON ST. • PITTSBURGH 19, PA

TOUGHEST ACID TEST OF ALL:

THESE ATLAS PICKLING TANKS PASS IT EVERY DAY AT ALLEGHENY-LUDLUM



Stainless steel is tough stuff in resisting corrosion, and to pickle stainless steel requires probably the strongest reagents used in industry. But, what the steel takes only momentarily, the pickling tank must take continuously . . . with minimum maintenance . . . and minimum down-time of the pickle line.

These tanks at two separate Allegheny-Ludlum plants hold a hot solution (160-170°F.) of nitric and hydrofluoric acids. An acid-proof membrane is protected by two courses of ATLAS carbon brick joined with ATLAS *Carbo Vitrobond* Cement.

Carbo Vitrobond is used because of its particular resistance to hydrofluoric acid. Similarly for all other applications, there are ATLAS corrosion-proof cements especially suited to the conditions. There is also ATLAS *Alkor 5E* Cement for broad-range resistance. *Alkor 5E* is the nearest approach to a universal corrosion-proof cement.

Success of any pickling tank installation depends on proper selection of materials. It also depends on highly specialized tank engineering. For this reason, ATLAS maintains engineering facilities solely devoted to pickling tank design. This engineering assistance is available to you locally through ATLAS sales engineers in your community.

CORROSION-PROOF CEMENT DATA is provided in Bulletin 5-2. A copy will be sent to you gladly upon request.

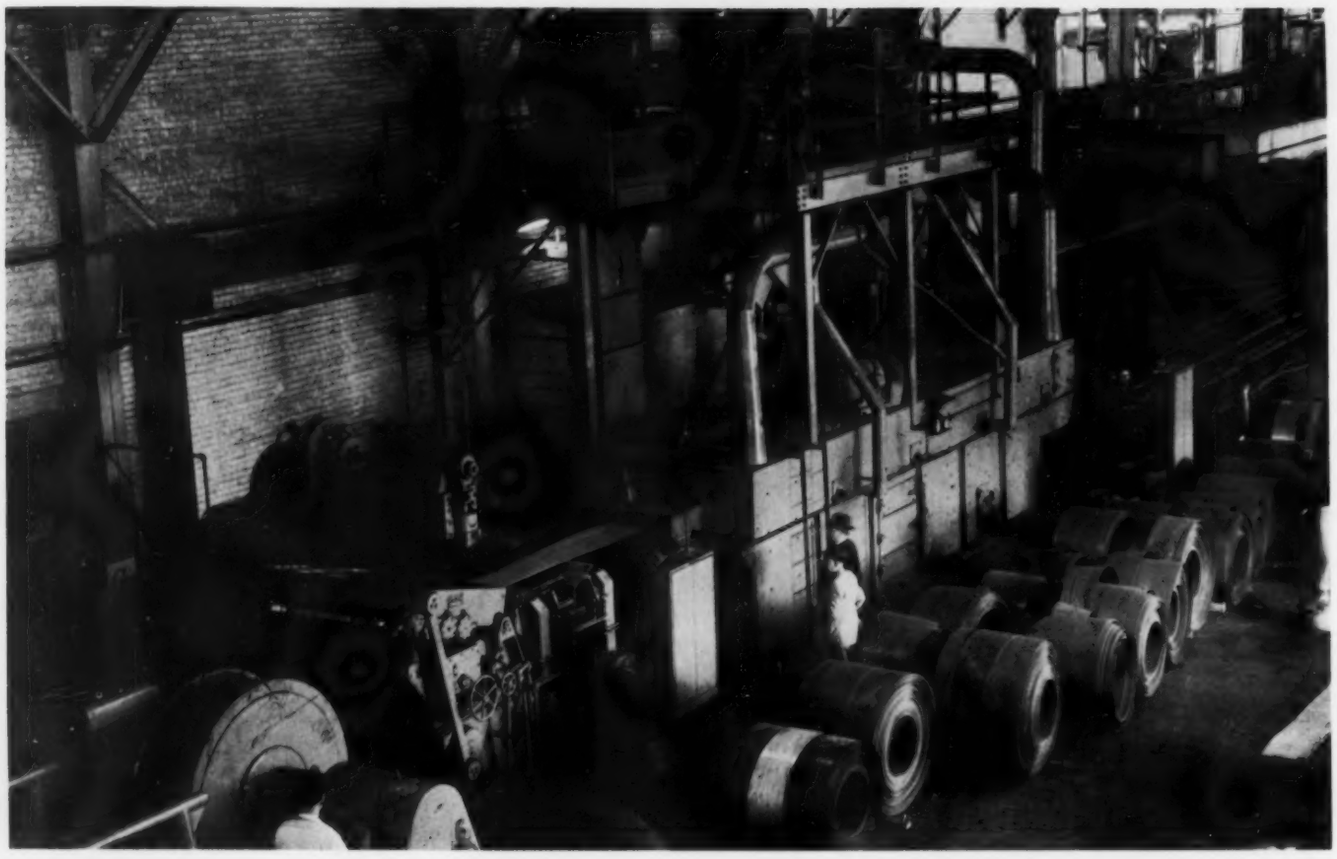
On the 56" annealing and pickle line at Allegheny-Ludlum's Brackenridge Plant, three tanks, each 60' long x 7'4" wide x 4'3" deep, are protected by ATLAS acid-proof brick and ATLAS corrosion-proof cement. This combination chemically resists the strong reagents . . . and physically withstands the factors of temperature and abrasion.

At Allegheny-Ludlum's West Leechburg Plant, two tanks, each 44' long, hold 7.8% HNO_3 and 5% HF at 160-170°F. Two courses of ATLAS carbon brick laid the 4½" way provide a 9½" thick sheathing.

ATLAS MINERAL PRODUCTS CO.
MERTZTOWN, PENNSYLVANIA

ATLAS . . . corrosion-proof cements . . . coatings . . . vessel linings . . . plastic structures.

pioneering developments keep **WHEELABRATOR®** *first in blast cleaning*



Blasting Stainless Steel Descaling Costs

new, low-cost method of descaling strip and sheet

The cost of descaling hot-rolled steel strip and sheet has been drastically cut by mechanical descaling with airless Wheelabrator blast cleaning. At the West Leechburg plant of Allegheny Ludlum Steel Corp., stainless steel strip is descaled without scale breaking. It takes only five men to operate the Wheelabrator descaling line compared to 24 men for the batch pickling operation which it replaced. The Wheelabrator requires only 6,000 sq. ft. of floor space compared to about 10,500 sq. ft. for pickling. The loss of virgin metal has been virtually eliminated and the scale removed is in an easily recoverable condition. Reduction of acid consumption has simplified their acid disposal problem.

Steel is descaled through the controlled impact of Wheelabrator Steel Shot hurled by centrifugal force upon the steel surface to be cleaned. The constant, uniform flow of steel shot from the Wheelabrator units combined with the even, steady movement of the steel through the blast makes this mechanical cleaning method the most efficient descaling process yet devised.

Wheelabrator mechanical cleaning has been profitably applied to etching mill rolls and has effected unusual economics in cleaning strip, sheet, bar stock and skelp. Send now for complete details. Send for Bulletin 894 "How to Descale Steel Strip Mechanically" and Bulletin 914 "How to Descale Steel Sheet at High Speed and Low Cost."

American
WHEELABRATOR & EQUIPMENT CORP.
396 S. Byrkit St., Mishawaka, Ind.

Wheelabrator®
AIRLESS BLAST CLEANING

FORT PITT BRIDGE

Engineers
Fabricators
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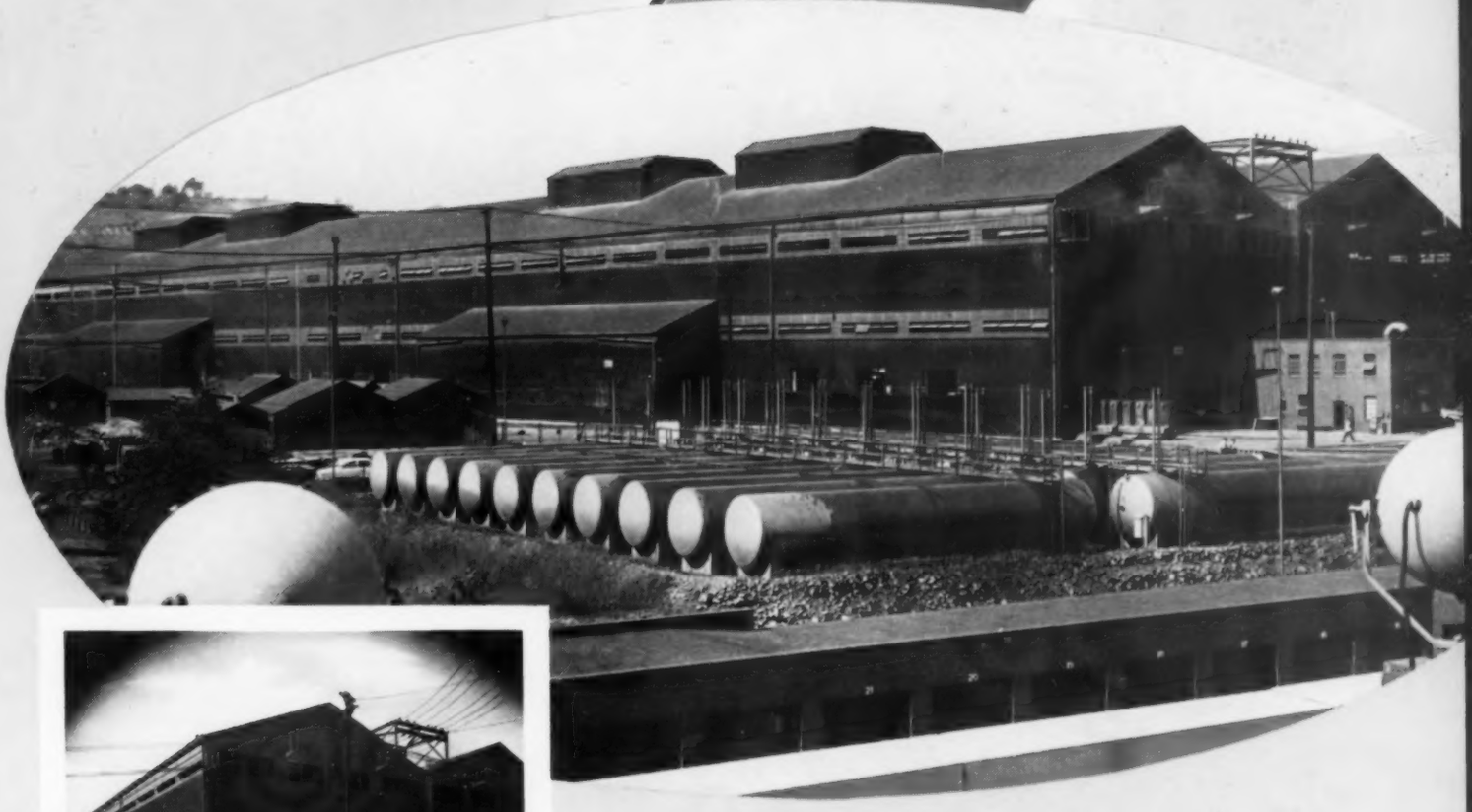

STEEL MILL BUILDINGS for the leaders in the Steel Industry

It has been our pleasure to work with Allegheny Ludlum Steel Corporation in their recent expansion program by furnishing the structural steel for the following new mill buildings: Melt Shop, Hot Strip Mill, Tandem Mill, Blooming Mill, Soaking Pit and Pickling Departments, as well as extensive alterations to other existing structures.

On your next structural steel project, why not utilize the experience and facilities of Fort Pitt—structural steel specialists for over 57 years.

There is no substitute for structural steel

AISC — AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC. — FOUNDED 1921

Steel Permits Streamlining Construction with Safety, Endurance and Economy

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they're...ROLLING with TSP

Shown above, 40" Blooming Mill
equipped with TSP Screwdown Screws and Nuts.
Photos at right, typical operations using TSP Leveller Rolls,
Work Rolls, Pinch Rolls, Backup Rolls and Gearing. Other TSP Products
used by Allegheny Ludlum include Track Wheels, Shaftings,
Herringbone Mill Pinions and Piston Rods.

THE STANDARD OF QUALITY SINCE 1909 FOR GEARS • PINIONS • ROLLS • WHEELS

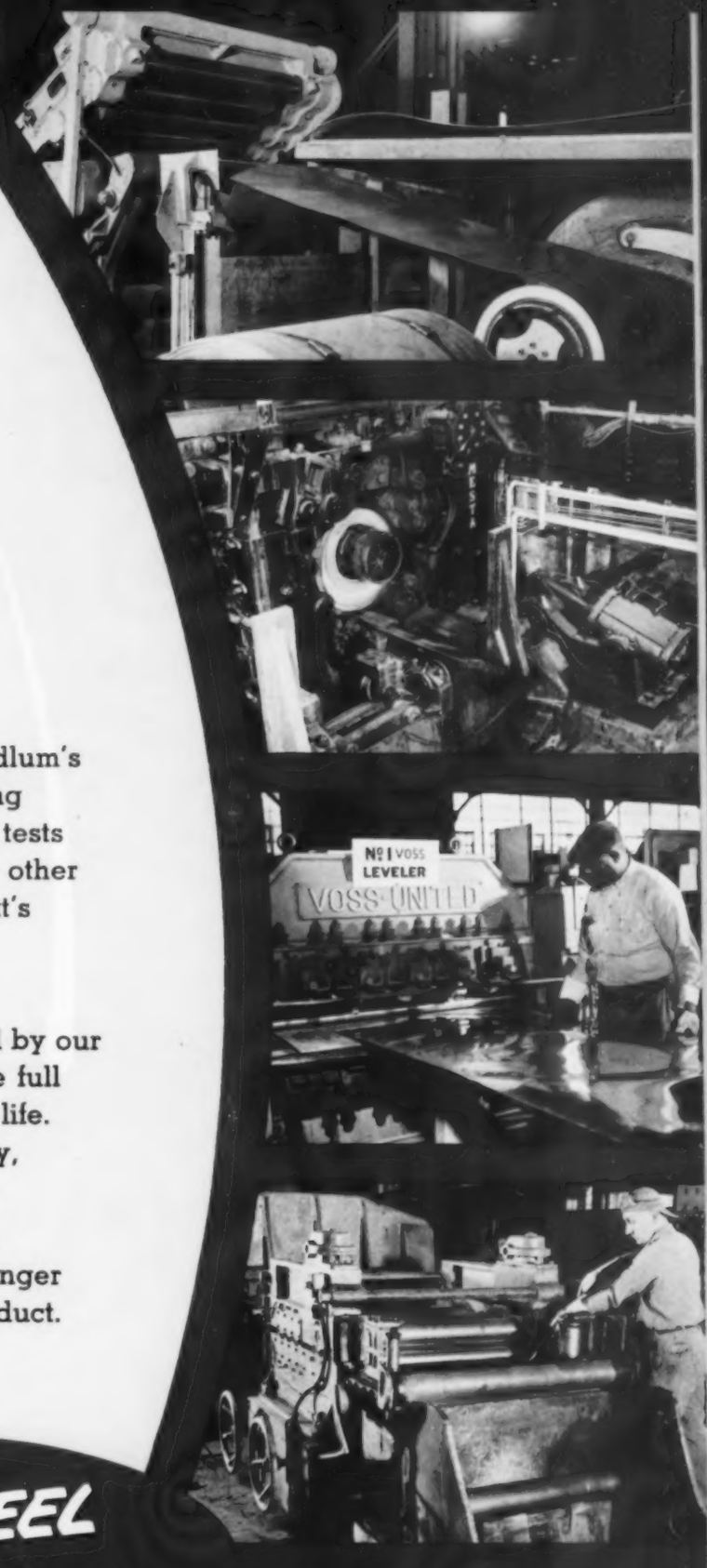
Ad 189

..at Allegheny Ludlum

In practically every phase of Allegheny Ludlum's operations, you'll find TSP products carrying more than their share of the load. Service tests have established TSP superiority over any other competitive materials previously used. That's why Allegheny Ludlum levellers are equipped with TSP Rolls.

Here's why.. TSP products are hardened by our special process. The file hard surface to the full depth of permissible wear gives maximum life. The core, refined for toughness and ductility, gives maximum strength.

You receive an absolutely positive written guarantee that TSP products will give a longer life in the same service than any other product. Write today for Bulletins.



THE TOOL STEEL GEAR AND PINION CO.
CINCINNATI 16, OHIO, U. S. A.

EELS AND OTHER HARDENED PRODUCTS

Program

ASSOCIATION OF IRON AND STEEL ENGINEERS

WESTERN MEETING

HOTEL STATLER

LOS ANGELES, CALIFORNIA

February 15, 16, 17, 1954

Monday, February 15

8:30 am — REGISTRATION

9:00 am — TECHNICAL SESSION — Sierra Room

Welcoming Remarks by Eric Anderson, President, Association of Iron and Steel Engineers.

"The Modern Electric Weld Pipe and Casing Mill," by Norbert C. Rubin, Vice President, Yoder Co., Cleveland, Ohio.

"Control for a Modern Resistance Weld Tube Mill," by Charles E. Smith, Application Engineer, Cutler-Hammer, Inc., Milwaukee, Wis.

"Mechanical Extrusion Press for Producing Tubes, Bars and Shapes," by Astor L. Thurman, Executive Vice President, Mannesmann-Meer Engineering and Construction Co., Easton, Pa.

2:00 pm — TECHNICAL SESSION — Sierra Room

"U. S. Steel in the West," by John L. Young, Vice President — Engineering, United States Steel Corp., Pittsburgh, Pa., and W. F. Pruden, Chief Engineer, Columbia-Geneva Steel Div., United States Steel Corp., San Francisco, Calif.

"The Economics of Replacement in the Steel Industry," by G. G. Beard, President and General Manager, United Engineering and Foundry Co., Pittsburgh, Pa.

"Electric Furnace Steel Production on the West Coast," by W. B. Wallis, President, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa.

"Helper Drives Help Steel Processing Lines," by E. E. Vonada, Steel Industry Application Engineer, The Reliance Electric & Engineering Co., Cleveland, Ohio.

Tuesday, February 16

9:00 am — TECHNICAL SESSION — Sierra Room

"Some Aspects and Trends as Disclosed in Recent Cold Mill Installations," by R. E. Noble, Engineer Rolling Mill Dept., Mesta Machine Co., West Homestead, Pa.

"Tension Regulator on Kaiser Temper Mill," by W. R. Harris, Manager, Industry Engineering Dept. and L. F. Stringer, Steel Mill Engineer, Industry Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

"Combination Bar and Rod Mill — Los Angeles Plant," by C. C Brandt, Superintendent, Electrical Dept., Bethlehem Pacific Coast Steel Corp., Los Angeles, Calif., and Phillip Scarola, Field Engineer, Elliott Co., Pittsburgh, Pa.

"The Processing and Drawing of Steel Wire," by P. A. Beaman, Manager, Wire Machinery Dept., Morgan Construction Co., Worcester, Mass.

2:00 pm — TECHNICAL SESSION — Sierra Room

"Blast Furnace and Coke Plant Expansion at Fontana," by Clarence R. Lohrey, Assistant General Superintendent, Iron and Steel Div., Kaiser Steel Corp., Fontana, Calif.

"Atomization of Liquid Fuel with High Pressure Gas," by George Grosvenor, Open Hearth Superintendent, Colorado Fuel & Iron Corp. Pueblo, Colo.

"Diversity of Products of Low Individual Tonnages," by W. J. McClung, Vice President, Steel Plant Operations, Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.

"Electric Systems for Main Drives," by W. E. Miller, Manager, Steel Mill Engineering, Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

7:00 pm — DINNER — Pacific Ball Room

Wednesday, February 17

Inspection Trip to Fontana Works of Kaiser Steel Corp. Buses will leave Hotel Statler at 8:30 am.

HOTEL RESERVATIONS

WRITE DIRECT FOR HOTEL RESERVATIONS TO HOTEL STATLER, LOS ANGELES, CALIF., GIVING TIME OF ARRIVAL AND TYPE OF ACCOMODATIONS DESIRED. RESERVATIONS SHOULD STATE THAT THEY ARE FOR AISE WESTERN MEETING.

DESIGN AND APPLICATION OF BRONZE SLIPPERS IN UNIVERSAL COUPLINGS

By J. ROBERT LOTTES
National Bearing Division
American Brake Shoe Co.
Cleveland, Ohio

. . . . slipper costs can be reduced by following some of the suggestions in this paper . . . .

▲ ROLLING mill stands in steel mills may be likened to other types of mechanical equipment to which an external source of power is applied. This external source may transmit its power to the equipment through shafting which may of necessity experience a change in direction. When this occurs, a break in the shafting is required and the subsequent loose ends which are exposed are connected together by some sort of coupling device. Original equipment manufacturers of rolling mill stands have designed and specified various types of couplings. In recent years, the universal coupling has become the most widely used.

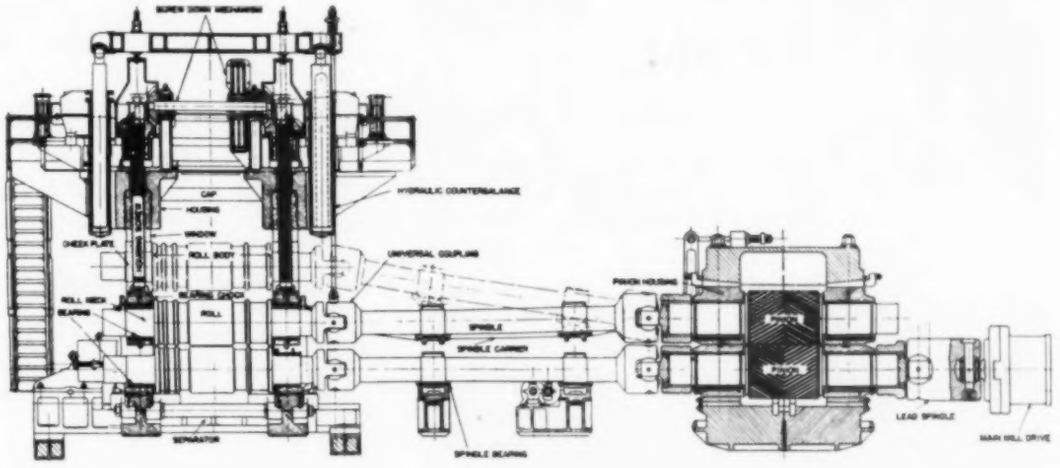


Figure 1 — Schematic cross sectional diagram of a hydraulically balanced high-lift reversing blooming mill indicates location of principal parts.

Figure 1 shows a cross section of a modern hydraulically balanced high-lift reversing blooming mill. Note that when the top roll is raised as far as it will go, the roll driving shaft or spindle is in an inclined position. It is possible to run this mill at this inclined position because of the universal coupling at each end of the spindle. The angle with which this spindle deviates from the horizontal is called the spindle angle or angularity.

Figure 2 shows the major components of the universal coupling. On the left is the jaw-half coupling. In the center, already installed in the jaw-half coupling, is the bearing segment assembly which is made up of two bearing segments on the bearing pin. On the right is the spade-half coupling.

As shown in Figure 3, the general shape or silhouette of a bearing segment—more commonly known as a "slipper"—is familiar to most steelmen, and is of sound engineering design. On-the-job investigation of a practical nature has been made and is in progress at the

Figure 2 — Principal parts of a universal coupling are shown.

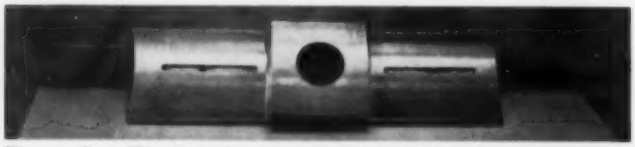


Figure 3 — The bearing segment is more commonly referred to as a slipper.

Figure 4 — Typical machining operation of sand-cast slipper shows operation on four at one time.

Figure 5 — Sand-cast machined slipper shown is of the threaded type.

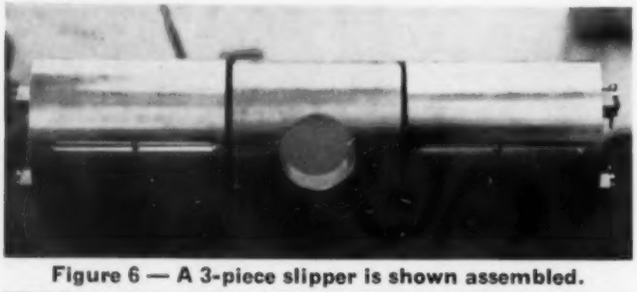
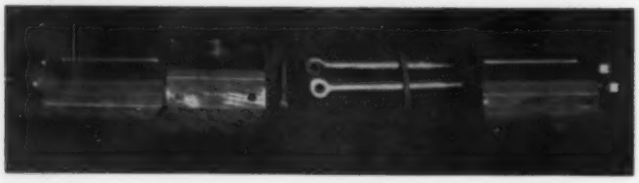


Figure 6 — A 3-piece slipper is shown assembled.

Figure 7 — Disassembled 3-piece slipper shows component parts.



present time in an effort to improve, not general external design, but rather design factors such as *method of manufacture* and *alloy*, in order to ultimately provide better service life and better economy to the user.

METHOD OF MANUFACTURE

The term "method of manufacture" is used here to identify the resultant product. Three methods will be discussed:

1. Sand-cast machined slippers.
2. Three-piece slippers.
3. Permanent mold slippers.

SAND-CAST SLIPPERS

First we will consider the sand-cast machined slipper. Slippers cast in sand are cast with sufficient stock for machining to size and tolerance specified.

Figure 4 shows the machining of the radius. Note that four slippers may be machined at one time, providing lugs are cast onto the ends of the slipper and proper fixtures are used. These lugs are of course later removed. The saving experienced by this method of machining may be one answer to present day increased operating costs.

Sand-cast machined slippers may be used on any mills, but since we will discuss later two new methods of manufacture: namely, the 3-piece slipper and the permanent mold slipper, we should mention at this point some factors which, from an economy standpoint, may indicate the continued use of the sand-cast machined slipper over the two newer methods of manufacture.

For example, a weight factor of over 150 lb per slipper will normally eliminate the possibility of using the less expensive permanent mold slipper, which will be discussed later, and will usually suggest the use of the 3-piece slipper. With slippers weighing less than 150 lb, quantity is the decisive factor in choosing between the less expensive permanent mold slippers or the sand-cast machined slipper. In this connection, low quantities such as on single stand applications would usually indicate that present sand-cast slippers be retained. The design factor may also suggest continued use of the sand-cast machined slipper as indicated in Figure 5.

This particular slipper is machined in the form of a large screw thread of slight angle, which does not interfere with the coupling action and it screws into the jaw-half coupling.

3-PIECE SLIPPER

Figure 6 shows an assembled 3-piece slipper which is of conventional overall shape. This design permits a certain amount of flexibility which results in better conformability.

Figure 7 shows the component parts of this patented slipper which are as follows:

1. Assembled end and center section.
2. Holding pin.
3. Forged steel "I" bolts.

4. Neoprene rubber spacer.
5. Machined end piece.
6. Castellated hex head nuts.
7. Safety cotter pins.

Another view of the disassembled slipper is shown in Figure 8. The design of the end piece may be modified to include the hex head nuts in recessed holes so that the nuts do not extend beyond the ends of the slipper. This particular design is especially adaptable to and is in use on blooming mills and slabbing mills. Mills of this type usually experience high torque and impact which cause severe slipper wear. When the 3-piece slipper is used, only the worn portions need be replaced as required without replacing the entire unit. Here again is one answer to present day increased operating costs.

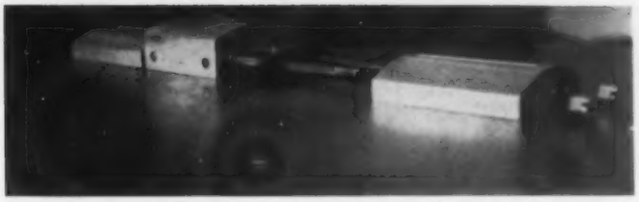


Figure 8 — This 3-piece slipper is particularly adaptable to blooming mills.

PERMANENT MOLD SLIPPERS

Consider now the permanent mold slipper shown in Figure 9. These slippers are vacuum cast in metal molds and are installed in universal couplings without machining. Tolerances are held to plus or minus 0.001 in. per in. depending on size. Close tolerance along with a cast surface finish of 100 to 125 micro-inches insures a good fit in the coupling, and the as-cast unmachined surface of the slipper provides a tough skin which will add to the life of the slipper. The use of a metal mold also eliminates any possibility of burnt-in sand particles on the surface of the slipper; burnt-in sand particles may often accompany sand castings with which the term "cast-to-size" is usually associated.

As mentioned before, size is a limiting factor in the production of slippers by the permanent mold process. The maximum or upper limit is in the neighborhood of 150 lb per slipper. This is somewhat arbitrarily determined by quantity requirements, since this process incorporates a metal mold—the cost of which should be written off in some manner over a given period of time.

As a general guide when analyzing one's particular slipper requirements, consider if the slipper consumption approximates 50 slippers of the same size per year, then it becomes economical to obtain slippers manufactured by the permanent mold process, because the cost of these slippers is lower than sand-cast machined slippers.

In certain operations similar to those shown in Figure 10, which shows the discharge end of a 68-in., 11-stand, 4-high, hot strip mill, relatively large quantities of slippers may be consumed in a short time, and by the use of permanent mold slippers, a definite saving will be realized. Here is another possible answer to present day increased operating costs.

ALLOYS

Bronze alloys used as slipper material may vary due to individual mill peculiarities and, when a change of alloy appears to be the answer to a troublesome installation, sound recommendations can only be made after a detailed investigation of the application.

Some of the alloys used at present are:

Phosphorus Bronze, 80-10-10, or SAE 64—This alloy is a composition of 80 per cent copper, 10 per cent tin, and 10 per cent lead, and will produce the following minimum physical properties:

25,000 psi tensile strength.
12,000 psi yield strength.
8 per cent elongation in 2 in.
60 Brinell hardness.

Machining becomes more difficult as 0.25 per cent phosphorus is added. In this state, the metal has a tendency to be open in structure which is not undesirable because of the microscopic amount of lubrication that can be absorbed.

Gear Bronze—SAE 65—This bronze is composed of 89 per cent copper and 11 per cent tin and has the following minimum physical properties:

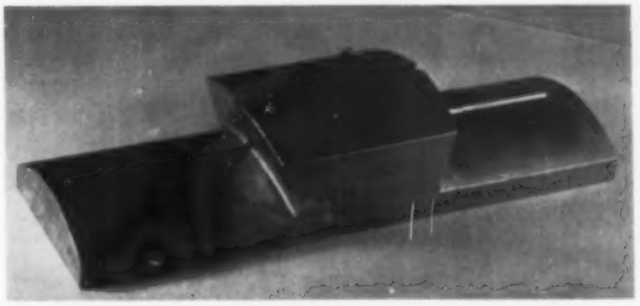


Figure 9 — Permanent mold slippers are cast in metal molds.

40,000 psi tensile strength.
21,000 psi yield strength.
15 per cent elongation in 2 in.
90 Brinell hardness.

On occasion the copper may be reduced and 1.5 to 3.5 per cent nickel added. This alloy gives excellent performance under high speed application with relatively good tensile strength and elongation.

Figure 10 — This 68-in., 11-stand, 4-high, hot strip mill requires many slippers.

Silicon Bronze—Silicon bronze is a copper silicon alloy containing iron, manganese or zinc depending on service and method of slipper manufactured. The physical properties may vary as follows:

45,000 to 65,000 psi tensile strength.
20,000 to 30,000 psi yield strength.
8 to 15 per cent elongation in 2 in.
60 to 80 Brinell hardness.

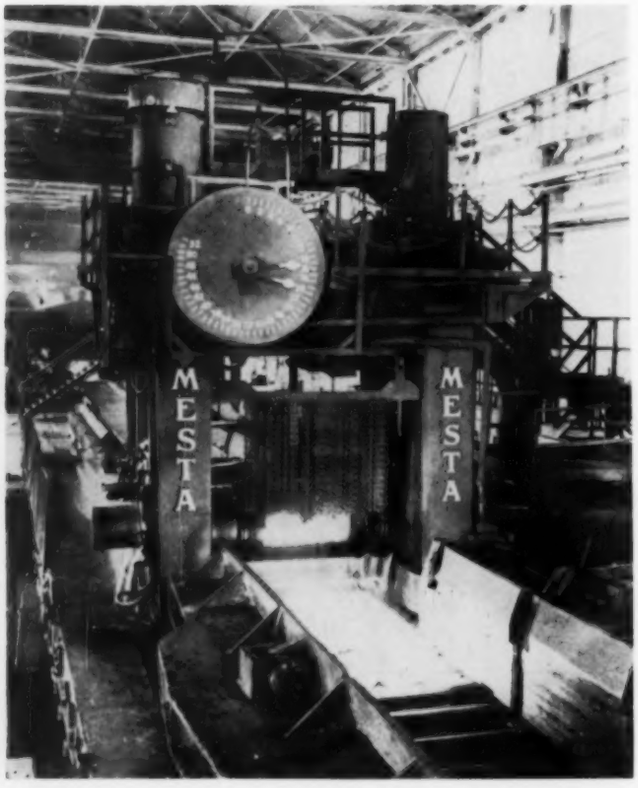
High Tensile Bronzes—Manganese Bronzes—SAE 43 and Modifications thereof—These copper-zinc alloys incorporate other elements—namely, aluminum, iron and manganese, and a range of minimum physical properties may be obtained from 65,000 psi tensile strength, 25,000 psi yield strength, 20 per cent elongation in 2 in., 100 Brinell hardness, to highs of 110,000 psi tensile strength, 60,000 psi yield strength, 12 per cent elongation in 2 in. and 220 Brinell hardness. SAE 430 for example will produce the following minimum physical properties:

90,000 psi tensile strength.
45,000 psi yield strength.
20 per cent elongation in 2 in.
180 Brinell hardness.

Aluminum Bronze—SAE 68 Grades A, B, or C—Depending on Iron Content—The aluminum bronzes are a family of copper—iron—aluminum alloys. A nominal composition of 89 per cent copper, 10 per cent aluminum, and 1 per cent iron will, in the sand-cast unheat treated state, produce the following minimum physical properties:

65,000 to 75,000 psi tensile strength.
25,000 psi yield strength.
20 per cent elongation in 2 in.
130 Brinell hardness.

Figure 11 — A 2-high reversing blooming mill. Such units do not necessarily use the alloys which work on strip mills.



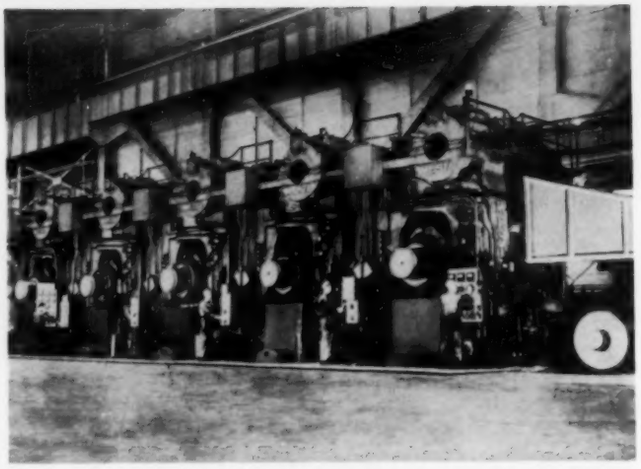


Figure 12 — On tandem cold strip mills, slipper life has been increased by going to high tensile manganese bronze.

If heat treated, this alloy will increase its physical properties to:

85,000 to 90,000 psi tensile strength.
40,000 psi yield strength.
12 per cent elongation in 2 in.
160 Brinell hardness.

A well known variation of this basic alloy is nickel-aluminum bronze and is composed of 80 to 84 per cent

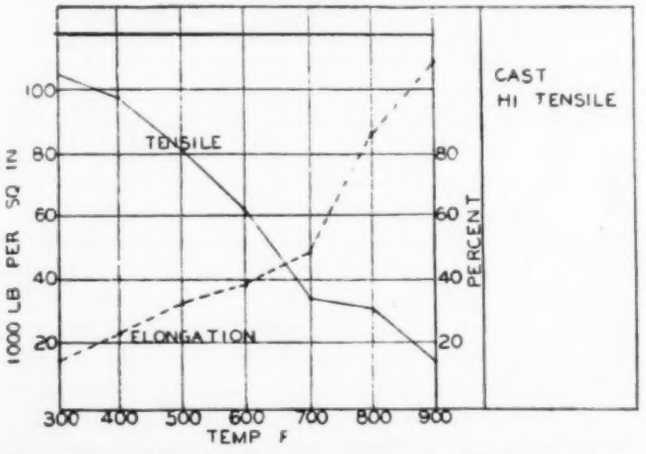


Figure 13 — Some high temperature properties of high tensile manganese bronze are given on these curves.

copper, 10 per cent aluminum, 2 to 5 per cent iron, and 2 to 5 per cent nickel. The physical properties of this alloy approximate those of the heat treated aluminum bronze just as the physical properties of SAE 430 high tensile manganese bronze exceed those of the heat treated aluminum bronzes. This is pointed out in order to exploit the savings which can accrue by simply avoiding the expense involved in heat treatment of aluminum bronzes by switching to nickel-aluminum bronze or high tensile manganese bronze. This situation has been often encountered when, for example, aluminum bronzes in the un-heattreated state are used on relatively fast strip mill operation, and yet do not perform satisfactorily in relatively heavy duty, slow moving blooming mill operation. It is natural to consider heat treatment of the aluminum bronze to produce higher physical properties required and yet, as pointed out above, the additional expense may be

avoided by turning to the nickel-aluminum bronze or SAE 430 high tensile manganese bronze.

One case history indicated that service life was increased 200 per cent on a 400-lb slipper in a 40-in., 2-high, blooming mill, similar to the mill shown in Figure 11, by changing from an un-heattreated aluminum bronze to the high tensile manganese bronze. Investigation showed this to be an excellent application of high tensile manganese bronze because of:

1. Slow speed.
2. Good lubrication.
3. Good preventive maintenance.
4. Good operating practice.
5. Moderate angularity or rubbing action.

In addition, this alloy is able to absorb the pounding

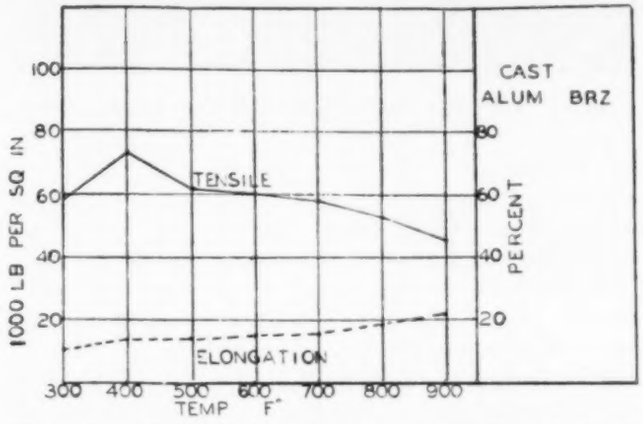


Figure 14 — Some high temperature properties of aluminum-bronze are given by these curves.

and impact transmitted to mill universals, which is characteristic of reversing blooming mills.

A similar case involved a 54-in., 4-stand, 4-high, tandem cold strip mill similar to the mill shown in Figure 12, where service life was increased 300 per cent by changing to high tensile manganese bronze. Again this showed to be a good application because of:

1. Good lubrication.
2. Good maintenance.
3. Good operating practice.
4. Moderate angularity.

Heat of friction and lubrication are important factors to be considered in the application of high tensile manganese bronze. Figure 13 shows the high temperature properties. As service temperature increases, the elongation increases and tensile strength decreases.

A comparison of nickel-aluminum bronze with high tensile manganese bronze shows the nickel-aluminum bronze to maintain an almost constant elongation up to 700 F and also shows the better high temperature tensile and yield strengths of the nickel-aluminum bronze.

Nickel-aluminum bronze is excellent for constant heavy loading, but its low elongation limits its use with intermittent loads. On a 96-in., 10-stand, 4-high continuous hot strip mill application it was found that by changing from aluminum bronze un-heattreated to nickel-aluminum bronze, service life was increased 50 per cent. This application was good because:

1. Loading was constant.
2. This material operated satisfactorily at elevated temperatures resulting from angularity and high speed.

Figure 15 — A uniform wear pattern is seen on one end of a slipper.

Figure 14 illustrates the physical properties of sand-cast aluminum-bronze un-heattreated at elevated temperature.

SUMMARY

The case histories discussed previously indicate that proper alloy selection can increase slipper performance and reduce operating costs. In each instance, the problem was approached by determining just what conditions were involved:

1. Kind of mill in question.
2. What material was being rolled.
3. Was leading constant or intermittent.
4. Maximum speed involved.
5. Spindle angularity.
6. Lubrication.
7. General operating practice and maintenance.
8. Investigation of previous slipper replacements or failures.

Examples of slipper failures are shown in the follow-

Figure 16 — Finned out slipper is due to pounding.

ing figures. Figure 15 shows a uniform wear pattern on one end of a slipper—typical of non-reversing mill installations.

Figure 16 shows a finned out slipper due to a pounding out action. Figure 17 shows a brittle fracture through the boss section.

The information obtained from an investigation of this type is a valuable aid in developing recommended changes of slipper alloy or method of manufacture.

Labor and metal costs are higher today than they have been in the past and there is little likelihood of a reduction in either in the immediate future. It is therefore hoped that this paper in some small way may contribute to lower costs in slipper maintenance.

Figure 17 — Broken slipper shows signs of a brittle failure.

DISCUSSION

PRESENTED BY

JOHN S. MORRIS, Supervisor of Construction, Lukens Steel Co., Coatesville, Pa.

J. ROBERT LOTTES, National Bearing Division, American Brake Shoe Co., Cleveland, Ohio

J. L. DUCHENE, Sales Representative, National Bearing Division, American Brake Shoe Co., Pittsburgh, Pa.

S. A. HUFFMAN, Superintendent Mechanical Maintenance, Kaiser Steel Co., Fontana, Calif.

John Morris: I would like to ask a question relative to the first figures. One of the slipper brasses showed considerable wear on one end only. In that instance would you recommend the use of the three-piece slipper which you described in your paper?

J. Robert Lottes: This would depend on the size and usage of the slipper. Unfortunately, there was nothing in the figure to indicate the exact size of this particular slipper since the purpose of these figures was to show typical wear patterns.

J. L. Duchene: I think it advisable to suggest that it was a slipper for a cold strip mill and, as a consequence, it would not be considered a good investment on which to use the three-piece construction or design, notwithstanding the fact that a definite wear pattern was shown on one end. On slippers of this type, the extra machining involved for the three-piece construction increases the price considerably.

S. A. Huffman: When these studies were conducted, was the same type of lubrication applied throughout all tests conducted?

J. Robert Lottes: Yes, we understand that the lubrication was exactly the same. We always endeavor wherever possible to keep all possible factors constant or consistent.

J. L. Duchene: That is true. We attempt to have slippers installed in similar couplings so as not to end up with a comparison from a worn coupling and a new coupling. We tried further to have tests conducted on mills rolling the same material, not one rolling armor plate for comparison with one rolling carbon steel. Consequently the tests were as consistent as it was possible to obtain them.

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FEBRUARY, 15, 16, 17, 1954

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The Story of Wire

By RODMAN R. TATNALL
Field Service Metallurgist
Wickwire Spencer Steel Div.
Colorado Fuel & Iron Corp.
Buffalo, N. Y.

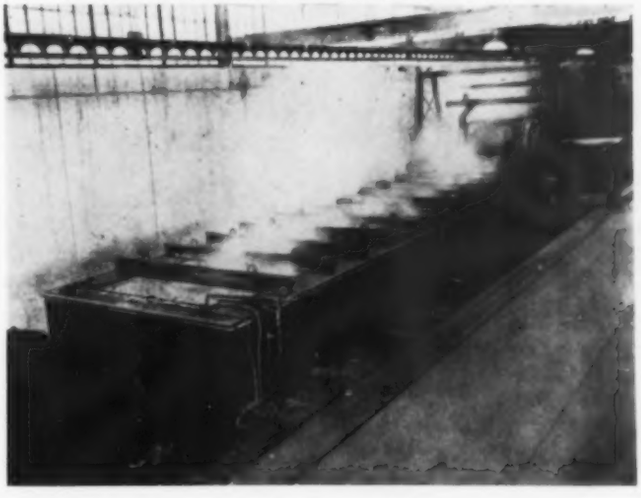
. . . . wire is one of the most important and diversified products made in the steel plant . . . .

▲ THE story of wire is similar in many respects to the growth and development of other forms of metal throughout this Iron and Steel Age. However, perhaps the story of wire deserves particular emphasis because of the fact that no other form of metal satisfies such a diversity of uses, whether from a functional, decorative, or economic point of view. Apart from the copper wire of the electrical industry, wire of precious metals in jewelry, and other metals or alloys for very special purposes, carbon steel wires in a multitude of sizes and grades find countless applications in our modern life, from the tiny hairspring in milady's wrist watch to the gigantic cables of the San Francisco-Oakland Bay bridge. This has followed from the fact that wire provides a shape and size of metal, with strength and workability, at a low cost, in combinations that can be matched by no other steel product.

In the sense that wire is a thin metallic filament, or thread, there is evidence that a crude form of wire was known as far back as 1700 B.C. A Latin manuscript of the 8th or 9th century describes the drawing of a hammered bar of lead-tin alloy through holes in a metal plate to make wire. It is believed that wire was drawn even prior to this to make the chain-mail worn by the crusading knights. Authentic records show that wire drawing was practiced on a commercial scale in France, Germany, and England by the 15th century. The first wire mill in this country was built in Connecticut in 1775. In 1812, a shop was set up in Spencer, Massachussets to experiment with fine wire drawing, which led to the foundation of the Spencer Wire Co. The year 1831 saw the founding of the Washburn & Moen Co., in Worcester. By mid-century, wire drawing was a full-fledged industry, and the small experimental mill in Spencer grew and expanded to become a very important part of the Wickwire Spencer group.

The wire drawn in this period was a crude product by present standards, starting from a small bar of wrought iron, heated and hammered to as small a "round" as possible, at best about 10 feet in length. This bar, when cold, was scoured bright with sandstone, and the end tapered. This end was then inserted thru a hole in a cast iron or hard steel drawplate and gripped by tongs attached to a lever. By this means the rod, lubricated, we are told, with butter or goose-grease, was pulled through the die in short intermittent strokes of the lever, each stroke leaving tong marks in the surface of the drawn wire. Fine wire was wound onto a hand operated drum, since the pull required

Figure 1 — It is essential that the rod be cleaned and scale removed before drawing takes place.



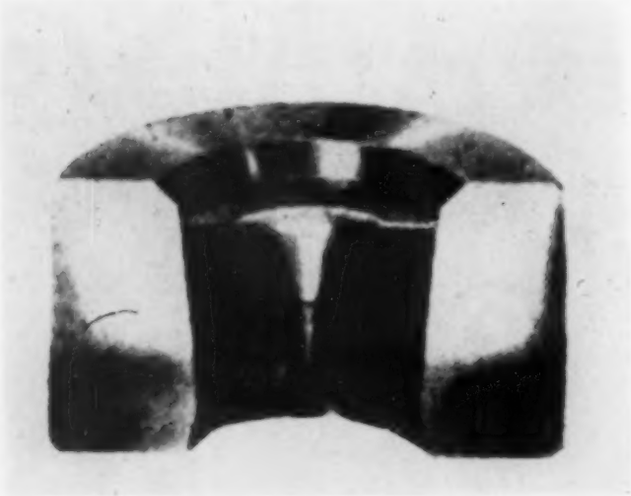
was not excessive, thus eliminating the surface damage and taking up much longer lengths.

Many factors entered into the growth of the infant industry. The development of bessemer and open hearth steelmaking resulted in a more suitable metal for drawing. Native American ingenuity overcame the obvious inefficiency of the lever-drawing system by application of power to larger and stronger drums. Innovations and improvements in methods of cleaning, coating, and handling, as well as in lubricants, kept pace with developments in machinery and sources of power. Along with the improvements in techniques within the wire mills, new demands on the product were continually made. The invention of the telegraph and telephone brought the need for long lengths of wire, increasing the pressure for a method of rod making to provide longer lengths to start with. It was only a short time before the Morgan and Garrett rod mills were perfected to meet this need. With the impetus of this highly beneficial development, inventions and new products from hoop-skirts to wire nails came thick and fast in the last half of the century, including such things as bale ties, barbed wire, coiled wire springs, and woven fence. Innumerable items using wire have developed since then, contributing, together with steady expansion of the major items already mentioned, to the continued growth of the industry to the point where about 5,000,000 tons of wire rods have been consumed annually in recent years.

As may be gathered from this history, the hot rolled rod is the raw material of the wire mill. Its preparation is strictly not a step in wire making, since the material is actually not wire until it has received one pass through the die. However, the steps taken to prepare the rod for drawing, that is, cleaning, coating, and drying, are of utmost importance to the success of the operation. These essential steps are taken at the pickling line, illustrated in Figure 1, where scale, rust, and dirt are removed in sulphuric acid solution, the pickled steel is rinsed and dipped in lime or other coating solution, and then thoroughly dried in forced air ovens, ready for the drawing machine.

The drawing operation is fundamentally the same today as it was hundreds of years ago—pulling the rod through a tapered hole. To be sure, the equipment is vastly different, and methods of handling throughout the process differ, but the heart of the process, the tool that does the work is the same simple tapered hole discovered centuries ago. Figure 2 shows a section of a modern wire drawing die. Beyond improvements in die materials, no fundamental change in its function has ever been needed. In principle, pulling the tapered rod-end through the die sets up a pressure between rod and die surfaces through the wedging action of the taper in the hole, to the extent that the yield point of the metal is exceeded and it flows through the die under the influence of the pull, taking the size of the exit, or small end, of the taper. This effect is shown schematically in Figure 3. It will be appreciated that this pressure also sets up tremendous friction in the die, and for this reason various lubricants have been developed to protect the wire surface and prolong the life of the die as much as possible. Partly from the friction and partly from the absorption of energy in working the metal, the wire becomes quite hot in its passage through the die. Twenty-five years ago, chilled iron or alloy steel was used for dies to draw coarse sizes, and diamonds for fine sizes. In the iron or steel die holes, wear was quite rapid as the wire passed through. An increase of two to three thousandths in wire diameter during the drawing of a 300-lb rod coil was not uncommon, and it was the wire-drawer's continual hope that this wear would be uniform, maintaining roundness of the wire, rather than one-sided or irregular, resulting in out-of-round or scratched wire. With the advent of tungsten carbide, about 1930, a die material approaching the hardness of the diamond became available for coarse sizes. The effect of this was to allow drawing through the same die hole 200 to 300 times the quantity of rods within the same size variation. This was all the engineers needed to proceed with a very important development, namely, continuous drafting from the rod, which will be discussed later on.

Figure 2 — The shape of a modern wire drawing die has changed very little throughout the years.



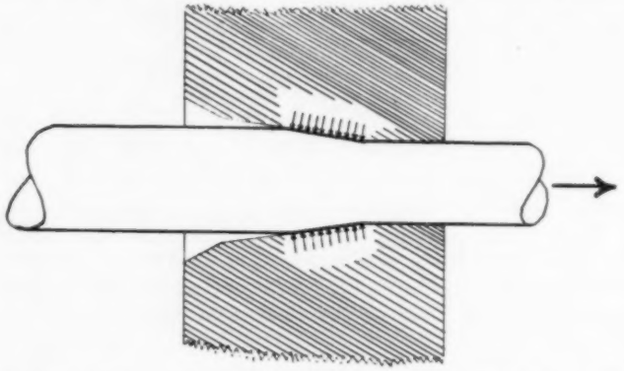


Figure 3 — Final diameter of wire is governed by exit size of die.

During the period just described, wire drawing machinery consisted in principle of a power driven drum or block, mounted on a bench or frame which also held a die box supporting the die and providing a holder for the lubricating substances so that they could be drawn into the die with the moving rod or wire.

It was learned early in the art that only a limited amount of cold reduction could be performed in one

Figure 4 — A typical wire drawing frame is illustrated in this view.

passage through the die. However, it was also learned that successive passes could be given to total an impressive reduction from the starting size. Instead of using one block and changing the die for each draft, machinery was readily adapted to provide several blocks side by side, each having the proper size of die in the series of reductions. Figure 4 is a view of a typical frame of this design. The rod coil was drawn onto the first block, removed to a reel or swift, drawn through the next die and onto the next block, and removed, and so on for five, six, or even more passes, depending on the size and type of wire to be finished.

The next logical step was to lead the wire from the first block through another die to the second, and so on, in order to eliminate the back-breaking labor and loss of time entailed in stripping each individual block. This, indeed, had been done for some time with sizes small enough to utilize diamond dies. The replacement of rapidly-wearing iron or steel dies with tungsten carbide met the need for constant accuracy of size in each draft demanded by this system, and other problems were soon overcome, to make continuous reduction of rods and coarse wire feasible and successful. One type of machine designed on this principle is shown in Figure 5. Study of butt-welding technique gave a further advantage in providing the continuous flow of rod to the machine necessary for full efficiency. This method can now give the rod as much as six or seven drafts with only one handling of the rod coil and one stripping of finished wire from the last block.

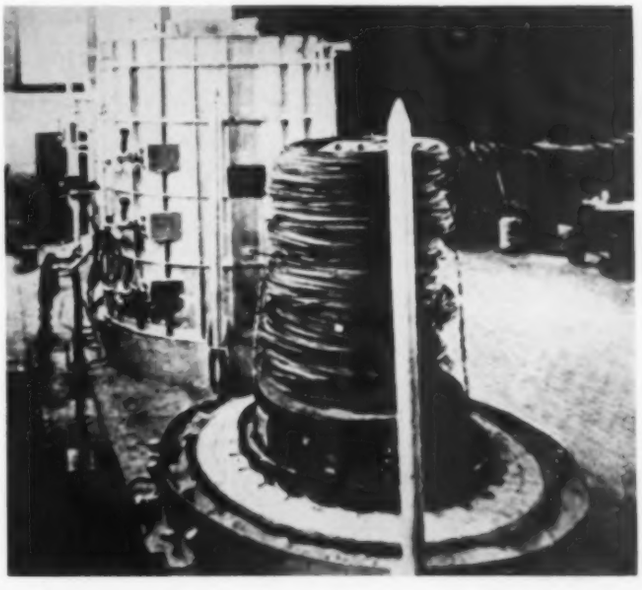
Modern continuous wire drawing machinery is a carefully engineered piece of equipment, electrically powered and controlled. The rod or wire passes through the first, or ripper die onto a drum or capstan, thence, over guide sheaves, to the next die and onto the next capstan. Thus, each capstan provides the power to make the reduction in its companion die, and each capstan runs at greater speed to take up the increased footage of the wire, with the finishing block operating at a speed up to 2000 fpm, depending on the type and size of wire. Some machines carry individual a-c motors driving each capstan with variable field arrangement, automatically controlling its speed according to the slight variation of wire length. Other machines are designed with gear drive to each capstan in a suitable ratio to provide the increased speed at each draft, with variation in wire length absorbed in a quantity of wire carried on each intermediate block. On all machines, special electrical controls are installed to provide slow starting speeds with gradual acceleration to full operating speed. A typical rod machine drawing wire to 0.148-in. finish size requires 155 hp and will take off about 24,000 lb in an 8-hour shift. A typical fine wire machine is provided with 25 hp, and, drawing 0.015-in. finish size, produces about 300 lb in the 8-hour shift. It may be of interest to point out that the production of 0.148-in. diameter amounts to 414,000 feet in length, while the production of 0.015-in. diameter is 504,000 feet in length.

The degree of drafting of steel wire is commonly measured in terms of percentage reduction in area from the larger to the smaller size. Thus a normal draft may be about 25-30 per cent reduction in area

Figure 5 — Machine shown was designed for continuous operation.

from the starting size, although it may be as low as 10 per cent, or as high as 35 per cent in some cases, depending on the grade and purpose of the particular wire. In this way, a $\frac{7}{32}$-in. (0.218 in.) rod, which is about the smallest size practical to finish in the hot rolling mill, can be reduced in successive drafts to 0.080-in. diameter, a total reduction of over 85 per cent in the area of the starting rod. Such a wire could be reduced somewhat more. However, the cold working of the metal in each reduction increases tensile strength and hardness,

Figure 6 — Low carbon steels are annealed in batch type bell furnaces.



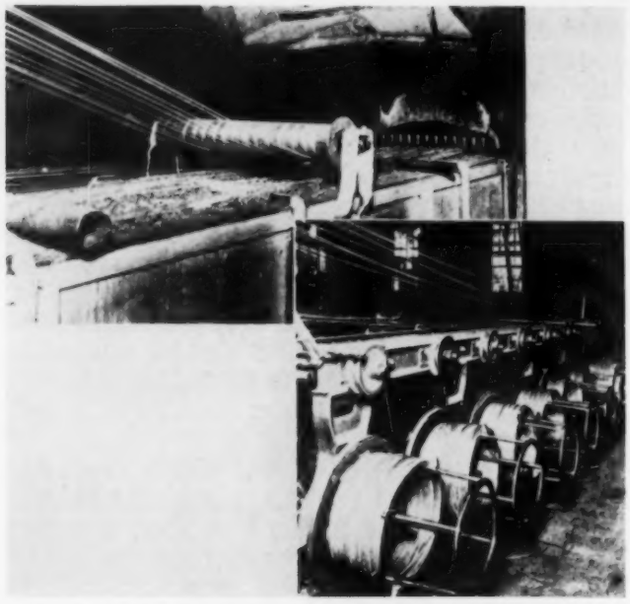


Figure 7 — View shows continuous heat treating furnaces regulated by automatic temperature control.

and sooner or later in the course of further reduction, depending on the grade of steel, ductility is impaired, perhaps to the point of actual fracture in the drawing operation. Since workability of the product must be

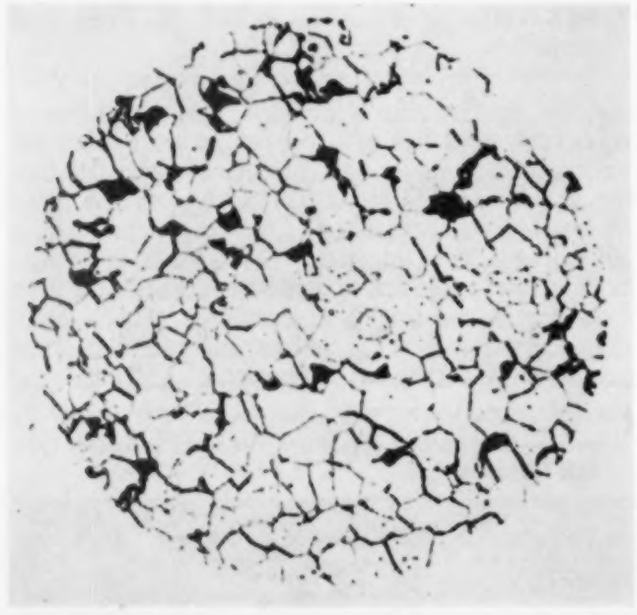


Figure 8 — Microscopic structure of low carbon steel is shown prior to cold work.

preserved, reduction is stopped short of the point where damage to toughness begins. In the case of fine sizes, such as 0.030 or 0.020-in., the wire undergoes a heat treatment at some suitable stage in the reduction which erases the effect of previous drafting on tensile and ductility. Following the heat treatment, as much reduction again, in terms of percentage, can be given if required. It is thus that total reductions from the rod of over 99 per cent are commonly obtained in making very fine wires.

The type of heat treatment given to wire depends on the grade of steel. Low carbon steels are annealed in batch type bell furnaces, illustrated in Figure 6, and the treatment consists essentially of heating the load just under the critical temperature and slow cooling. High carbon wires are seldom annealed for further wire drawing, because the annealed structure of these steels does not lend itself to the cold flow of metal caused in the die. A much more suitable structure is obtained in a form of normalizing treatment which is known as patenting, in the wire industry. This treatment is carried out with wire by passing strands through a heating furnace in which its temperature is raised well above the critical, and providing controlled cooling at the exit, either in air or in a molten

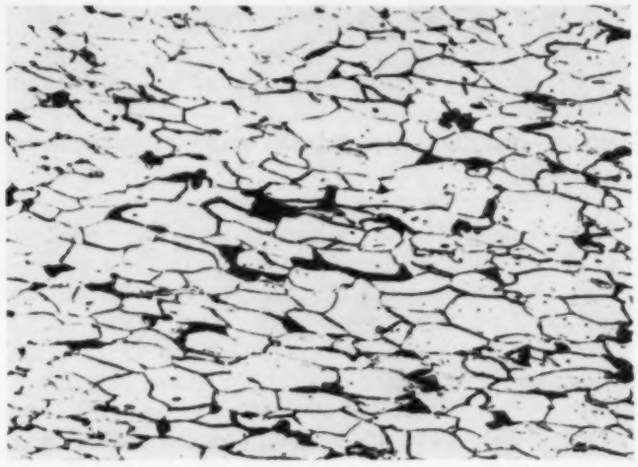
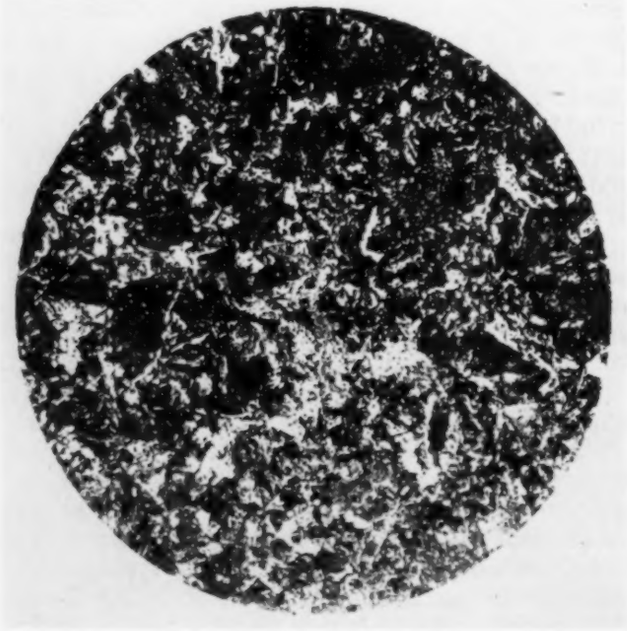


Figure 9 — Cold drawing elongates the shape of the metallic grains.

lead bath. The method of handling the wire strands is shown in Figure 7. Control of temperature and rate of cooling in this treatment develops a combination of strength and toughness in the drawn wire that can be obtained in no other way.

Figure 8 shows the microscopic structure of low

Figure 10 — Structure of patented wire is illustrated by this micrograph.



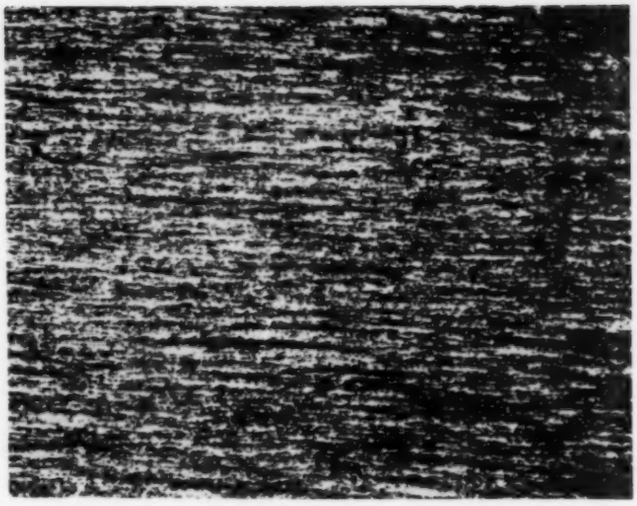


Figure 11 — Deformed crystals are shown for cold drawn high carbon steel wire.

carbon steel prior to cold work, and Figure 9 the effect on this structure of the drawing operation. The longitudinal flow of metal caused in the die is well shown by the deformed grains of the latter structure. The structures of patented, in Figure 10, and of cold drawn, Figure 11, high carbon steel show the same effect. A comparison of the structure of spheroidize-annealed high carbon steel, Figure 12, with that of the same steel patented makes apparent the fact that the uniform fine

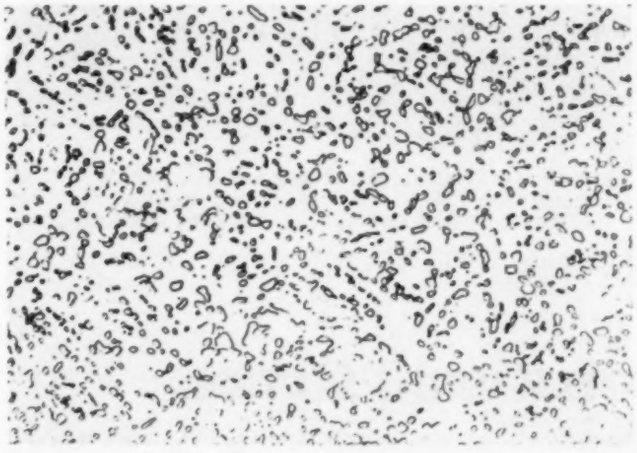


Figure 12 — Wire shown here has been annealed to give spheroidal shape crystals.

particle size of the latter will have a more uniform response to cold working than the mixed, or heterogeneous, structure of the former.

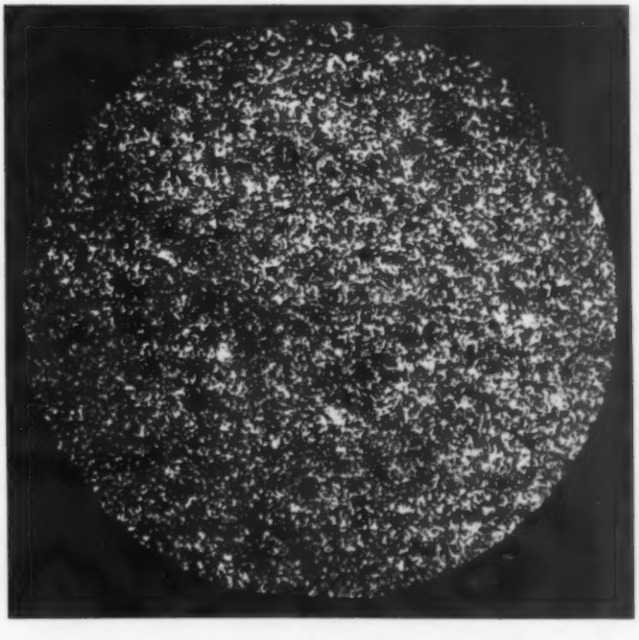
In regard to the physical properties of finished wires, an attempt will be made to cover a vast field in a few brief words. Steel wire can be produced within an extreme range in tensile strength from 50,000 psi in low carbon wire annealed at finish size, up to 500,000 psi for very small sizes of 1.00 per cent carbon piano wire. Within these extremes, it is important to note that properties of toughness are fully as necessary in almost all wire applications as is strength. In this respect, most wires, even in the very high tensile grades, must meet the common test of wrapping around its own, or twice its own diameter, depending on the size, without fracture. Each grade of wire has specific requirements it must meet, practically always measured by tensile strength, and often by specific tests for toughness, workability, or some characteristic related to its ultimate use. Thus a great variety of specialty wires are tailor made for the job they are expected to do.

In order to meet the varied characteristics demanded of his product, the wire manufacturer has three elements under his control. The analysis of the steel, the heat treatment given, and the amount of cold reduction are inter-related factors which determine the mechanical properties of the drawn wire. Steel wires all work harden about the same amount—that is, after cold working show about the same increase in tensile strength—regardless of analysis. Both analysis and heat treatment determine the tensile strength of rod or wire prior to drawing, and the amount of cold work is regulated by the size at which heat treatment is given. By applying combinations of these factors, practices are developed in each case to provide the most suitable properties in a wire for its particular purpose.

One type of wire, very important in its field of application, differs in many respects from the usual cold drawn wires. This type is known as oil tempered spring wire, and its structure. Figure 13, shows none of the effects of cold flow of metal. After this wire is cold drawn to size, it is passed in continuous strands through heating, quenching, and tempering baths, so that its mechanical properties are established, not by cold work, but by the hardening and tempering process. From this treatment, superior elastic characteristics are obtained, and the wire finds extensive use in a wide variety of mechanical springs.

Any attempt to outline the uses of wire in our present life meets first the obvious uses, such as wire ropes in hoisting cables, tow lines, ships' rigging, and the like; mandolin or piano strings; and of course wire fence of various types. Many uses not so obvious are found giving necessary strength to tire beads; comfort to the

Figure 13 — Crystal and structure of oil tempered spring wire differs from most of the regular cold drawn wires.



chairs and beds in our homes; or reinforcement to the concrete roads we drive on. A thousand and one gadgets in our daily lives testify to the vast number and quantity of goods manufactured from wire. Coat hangers; can-keys; dish-drainers; hairpins; screwdrivers; screws, bolts, and nails; and even the screens on our windows; all are available at low cost because of the characteristics of wire. There is hardly a mechanism of industry that does not depend upon, or benefit from a coiled wire spring for its operation or control. Through its versatality, adaptability and economy, wire has come to fill an amazing number of needs in our modern way of life.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, January 25, 1954 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Gas Turbines for Blast Furnace Gas," by D. R. Jenkins, Manager, Gas Turbine Application Engineering, Westinghouse Electric Corp., Philadelphia, Pa.

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Tuesday, January 12, 1954 — Dinner 6:30 P.M., Meeting 8:00 P.M.

Maintenance Symposium —

"Metallurgical Plant Maintenance," by T. G. Bradbury, Laboratory Metallurgist, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada

"Economy Realized Through Strain Gauge Checks," by R. P. Gibson, Field Engineer, Republic Steel Corp., Buffalo, N. Y.

Hotel Sheraton, 715 Delaware Avenue, Buffalo, N. Y.

▲

CHICAGO SECTION

Tuesday, January 5, 1954—Dinner 6:15 P.M. Meeting 7:45 P.M.

"Gas Turbines Place in Industry," by T. J. Putz, Manager, Gas Turbine Engineering Dept., Westinghouse Electric Corp., Philadelphia, Pa.

Phil Smidt's Restaurant, 1205 N. Calumet Avenue, Hammond, Ind.

▲

CLEVELAND SECTION

Tuesday, January 19, 1954 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Productive Electrical Maintenance," by A. D. King, Superintendent of Service, General Electric Co., Cleveland, Ohio

University Club, 3813 Euclid Avenue, Cleveland, Ohio

DETROIT SECTION

Tuesday, January 12, 1954 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"A Symposium on Material Handling," by G. Lee Berry, Manager, Plant Engineering Department, Steel Division, Ford Motor Co., Dearborn, Mich.

Dearborn Engineering Laboratories, Dearborn, Mich. "Meridan Room"

▲

PHILADELPHIA SECTION

Saturday, January 9, 1954 — Dinner 6:00 P.M., Meeting 7:00 P.M.

"Modern Methods of Communication at Lukens Steel Co.," by G. P. Cardwell, Electrical Design Engineer, Lukens Steel Co., Coatesville, Pa.

"Extensions to Electrical Generating and Distributing Systems at Sparrows Point," by H. D. Ruger, Assistant Electrical Engineer, Bethlehem Steel Co., Sparrows Point, Md.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

▲

PITTSBURGH SECTION

Friday, January 11, 1954 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

Maintenance Symposium —

"Field Repair of Large Rotating Machinery," by M. J. Wohlgemuth, Manager Electric Service, Westinghouse Electric Corp., East Pittsburgh, Pa.

"Transformer Maintenance," by B. L. Britt, Manager, Electric Service Department, Wagner Electric Corp., St. Louis, Mo.

"A Safety Limit Stop," by R. J. Harry, Vice President, Alliance Machine Co., Alliance, Ohio

▲

YOUNGSTOWN SECTION

Monday, January 25, 1953 — Dinner 6:30 P.M., Meeting 8:00 P.M.

Paper to be announced later.

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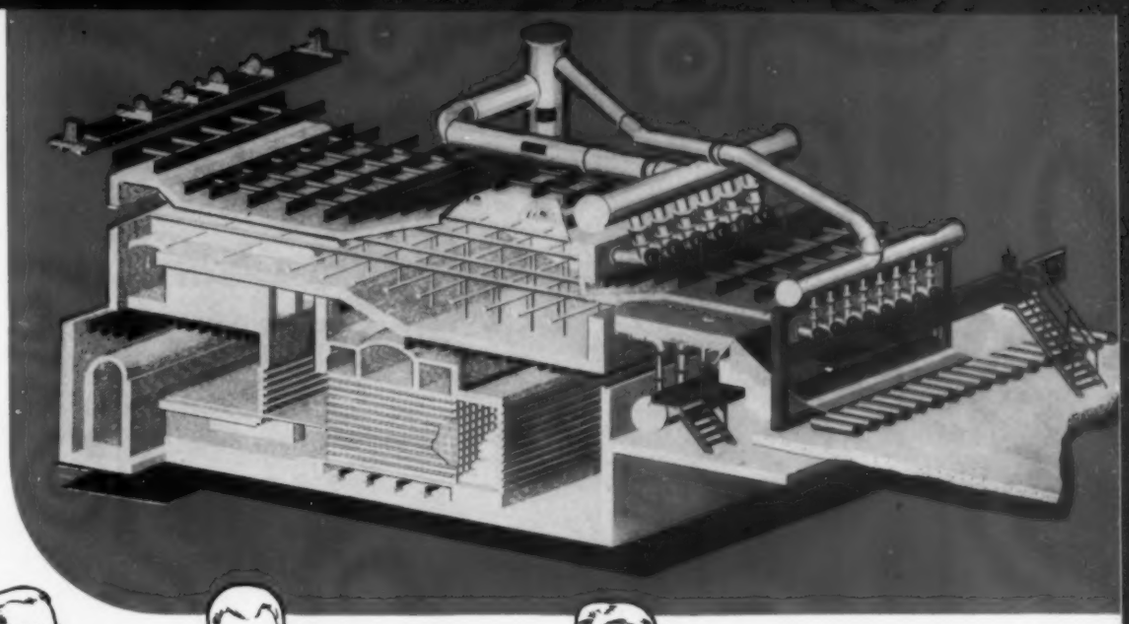

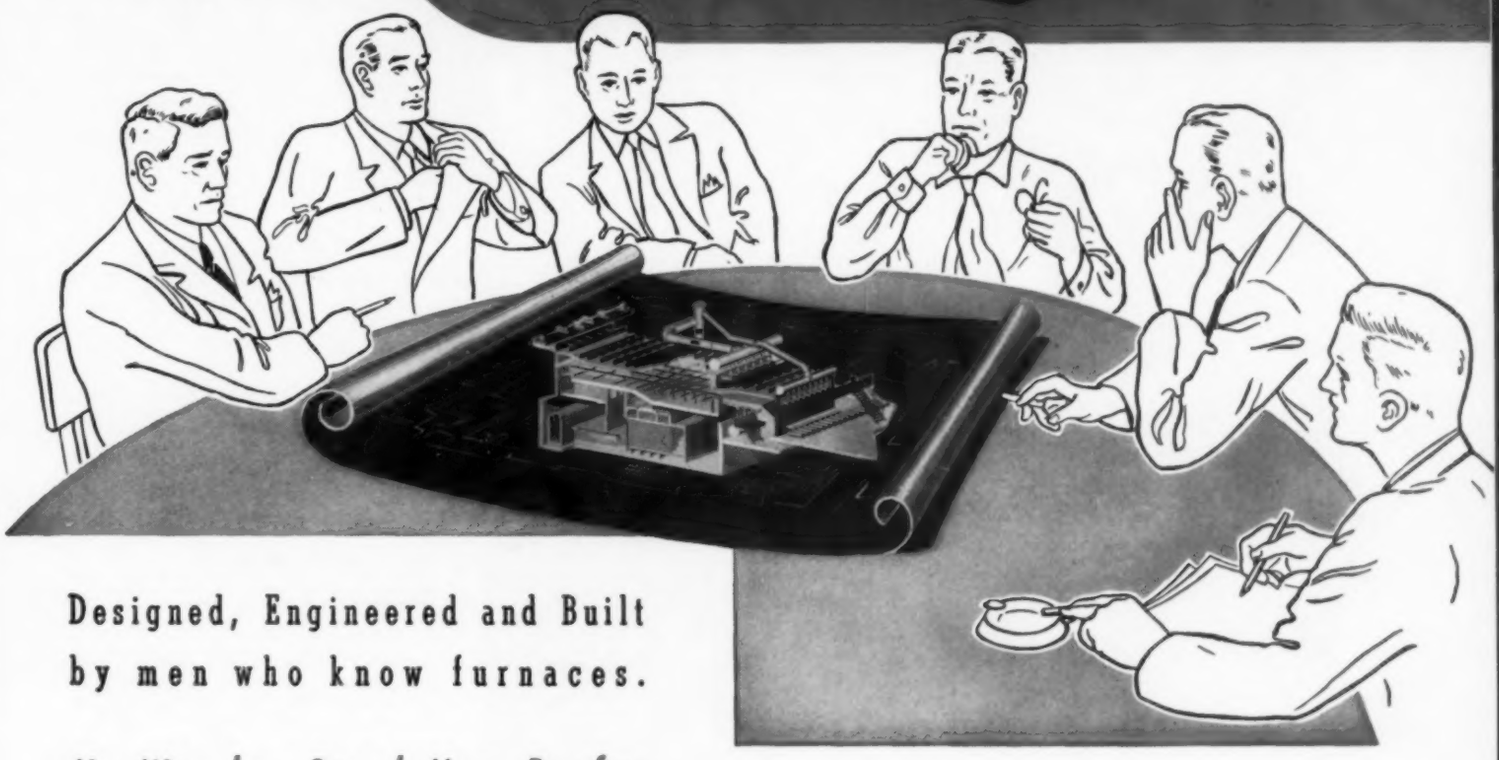

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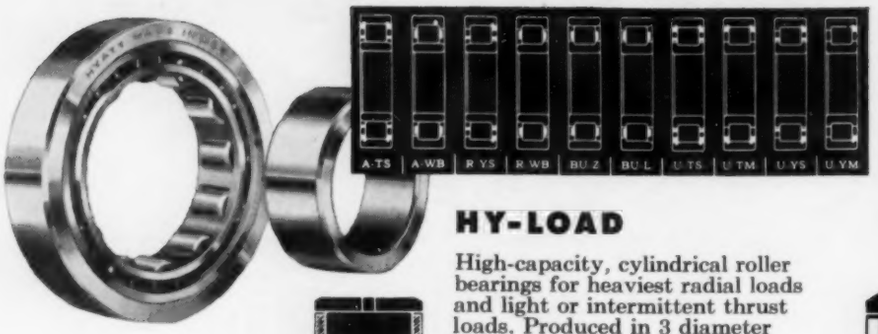

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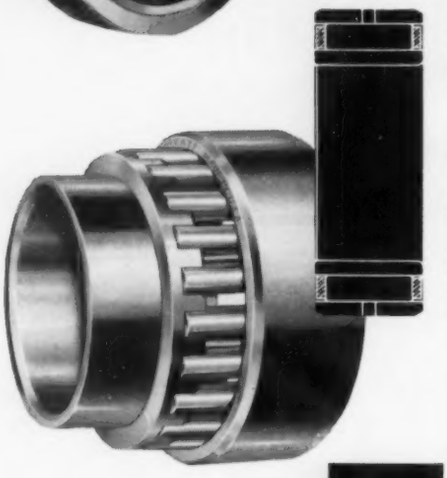

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This is a three-part separable bearing available in various width classifications. The roller construction provides maximum resistance to shock, abrasion and fatigue.

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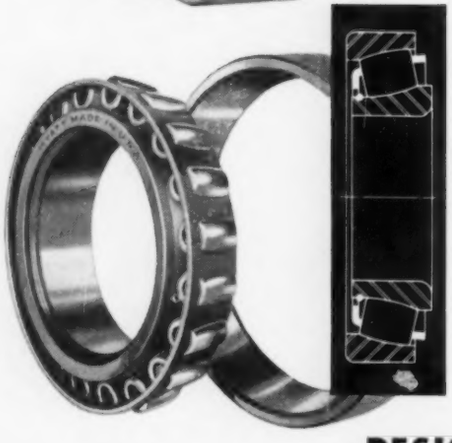

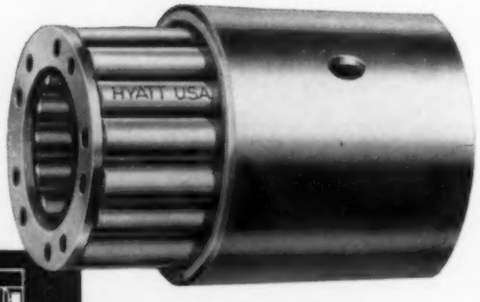

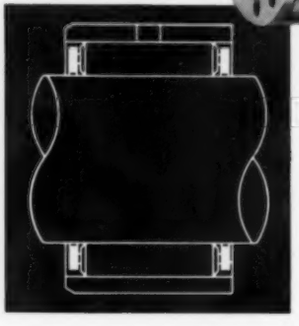

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HYATT ROLLER BEARINGS

...and there's a type and size for every need

Hyatt's complete line of radial and angular-contact bearings—*more than 800 sizes in the Hy-Load series alone*—makes the engineers' job easier, because it makes possible greater design flexibility. For the equipment *buyer*, this means longer bearing life and lower maintenance costs—with just the right bearings designed into every vital load-carrying position.

The next time you buy new equipment, or make a changeover, *specify lower maintenance costs by specifying Hyatt Bearings!* And if you need technical help in your selection of bearings, or desire information about particular bearings or their applications, ask for the services of a Hyatt sales-engineer. Call or write Hyatt Bearings Division, General Motors Corp., Harrison, N. J.

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION

FRENCH STEEL COMPANY INSTALLS REVERSING COLD STRIP MILL

. . . . article is based on information sent by Messrs. A. Bador, Managing Director, and H. Meurisse, Chief Engineer of S. A. Etilan, Jeumont, France . . . .

▲ INTERNATIONAL engineering is credited with a French steel company's success in producing extremely thin strip for French industry. The rolling mill is American; electrical equipment is German; the electrical equipment was assembled under the supervision of German engineers; and the finished product is supplied to steel fabricators in France.

The concern Societe Etilam, of Jeumont, France, since March, 1952, has rolled thousands of tons of thin-gage strip, gradually increasing overall plant production by about 25 per cent. This increase was made possible by the installation of a 20-in. (508-mm) Y-mill, built by Mackintosh-Hemphill Co., Pittsburgh, Pa.

Within a year, the company expects to expand output by running the plant 16 hours per day, and to augment the hourly production through improvement in regularity of operations.

Current practice calls for speeds up to about 340 meters per minute (1115.48 ft) in reducing Thomas steel (basic bessemer) strip from 2mm (0.0787-in.) to 0.50mm (0.0197-in.) in four or five passes. The average reduction is 25 to 30 per cent. Strip is between 300mm (11.8-in.) and 400-mm (15.75-in.) wide.

During initial operations, production averaged 480 kg (1058.25 lb) per hour of thin strip (0.11mm or 0.004-in.) and 1100 kg (2425 lb) of heavier gage strip (0.50mm or 0.0197-in). Today 520 kg (1144 lb) of thin strip is being produced.

The Mackintosh Y-mill, so named because of the Y-shaped arrangement of the rolls, is a 20-in. (508mm) reversing cold mill. The mill consists of seven rolls arranged in the shape of a "Y." From top to bottom the rolls are: two principal back-up rolls (450-mm, or 17.7168-in. in diameter); two intermediate back-up rolls (156mm or 6.1418-in); upper work roll (92mm or 3.6211-in.); lower work roll (156-mm) and lower back-up roll (492mm or 19.37-in.). Three of these rolls, the intermediate back-ups, are driven.

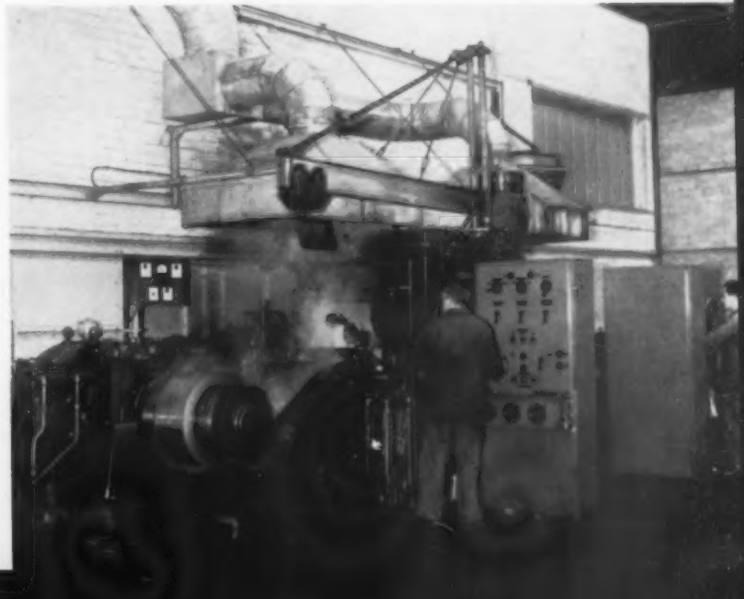
Built under a licensing agreement with the inventor, A. B. Montgomery, Pittsburgh consulting engineer, the Mackintosh Y-mill is the first reversing cold strip mill to combine the advantages of small diameter work rolls with the power required for deep draft and high speed.

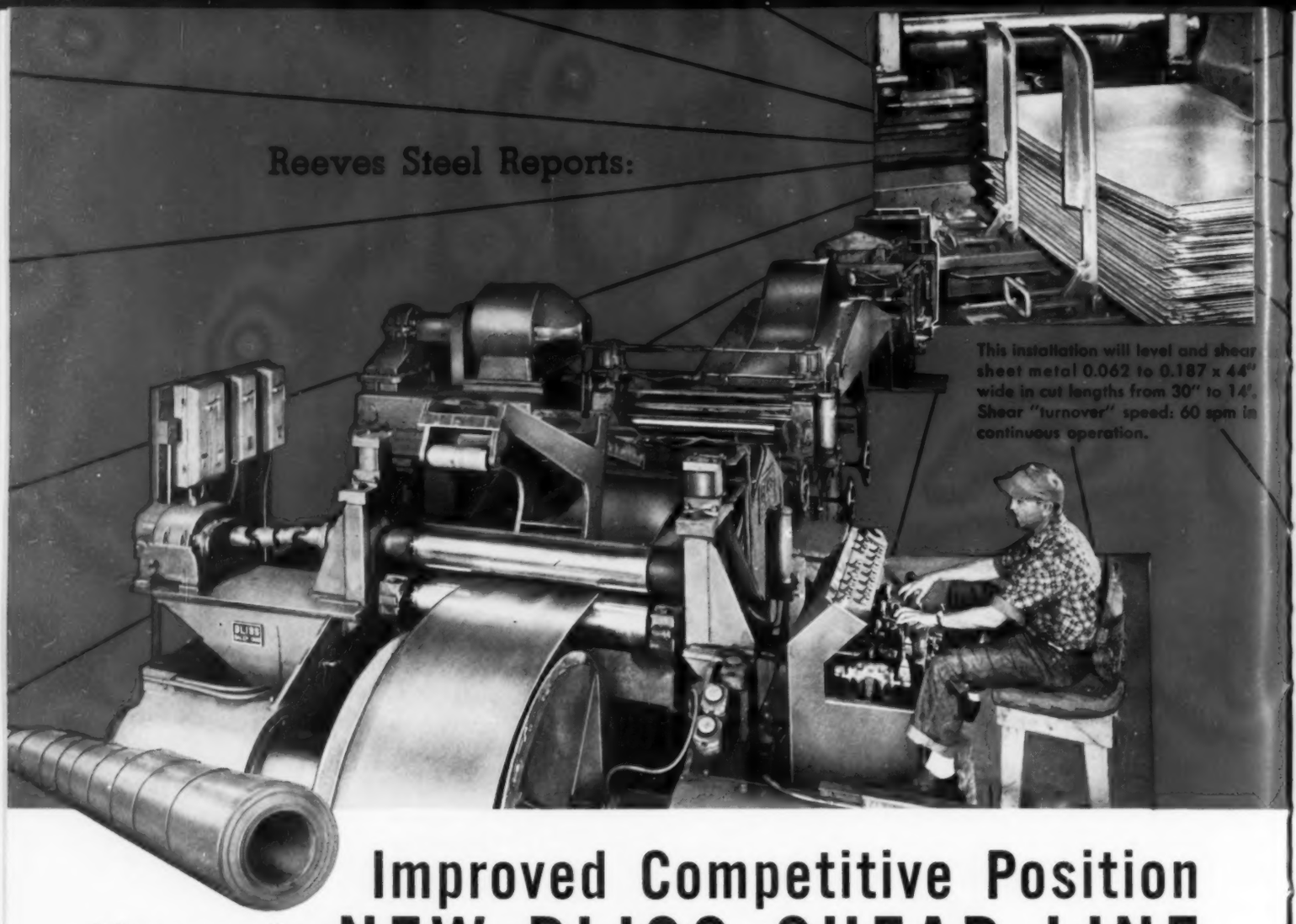
Accurate finished gage and improved surface finish of cold rolled strip, plus greater roll penetrating ability were some of the features the French company's engineers were looking for when they specified this mill.

Foundations for the mill were laid by a regional contractor under the supervision of Etilam engineers. The erection was made solely by Societe Etilam according to complete drawings furnished by Mackintosh-Hemphill. Regardless of weight and complexity of various parts, the mill was assembled in a minimum of time. Electrical equipment were supplied by the German firm A. E. G. Layout

Figure 1 — Entry side of Y-mill shows uncoiler, threader-leveller, and mill with tension reel in operation. When an odd number of passes are used, coils may be discharged from this side.

Figure 2 — Delivery side tension reel is coiling thin strip (0.005-in.) at high speed. Jib crane above mill expedites roll change.




Reeves Steel Reports:
This installation will level and shear sheet metal 0.062 to 0.187 x 44" wide in cut lengths from 30" to 14'. Shear "turnover" speed: 60 spm in continuous operation.

Improved Competitive Position through NEW BLISS SHEAR LINE

Coil is transformed into stacked, cut sheets at rates up to 200 fpm

Installing this shear line engineered to their own requirements and switching steel purchases from pre-cut blanks to coiled stock, Reeves Steel and Manufacturing Company of Dover, Ohio, profited three ways:

- They gained control of an important phase of their production while amortizing their own equipment.
- They eliminated the mill's "extra" charges.
- They reduced expenses of storage and record keeping.

Like others, Reeves chose Bliss after comparison with standardized machinery. Nine* vital operations assuring scratch-free surfaces, blanks of uniform flatness and perfect shearing explain why.

Such clearly-defined benefits from Bliss engineering help to account for the prominence of Bliss rolling mill equipment throughout the metal-producing industry.

Although principally in use in steel plants, the Bliss shear line can be of equal advantage to manufacturers, fabricators and warehouses.

You can read a comprehensive description of this machinery in the revised Bliss Rolling Mill Brochure by simply sending for it today. It's likely you'll see there Bliss equipment relating to *your* problem. When you do, Bliss' Engineering Department is as handy as your telephone... wherever you are!

**(1) Coil conveyor delivers coil to (2) coil box pay-off. (3) Coil is threaded to leveler; (4) flattened; (5) gaged to length (6) cut; (7) conveyed and finish-levelled; (8) fed and (9) stacked for banding.*

Remember: BLISS for Presses, ROLLING MILLS, Special Machinery

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of motors, main and auxiliary controls and connections was done by two German electrical engineers assisted by Etilam personnel.

On March 21, 1952, the first strip was threaded into the rolls. Operations were taken over by the suppliers' engineers. Testing the reel tension and its proper adjustment took several days. A production schedule was attempted on April 4, with extra-mild annealed strip 330mm (13-in.) wide and 1.7mm (0.067-in.) thick. Preliminary rolling had been done on a two-high mill.

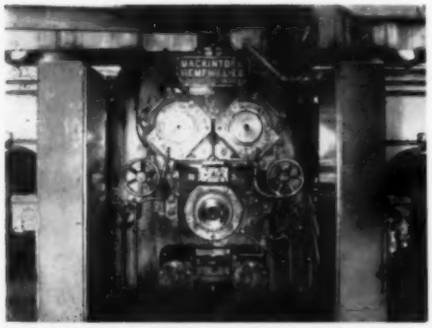


Figure 3 — Side view of Y-mill shows arrangement of work and back-up rolls. Fully enclosed "screw down" is under bottom back-up roll.

Initial coils had a 2mm gage. These were reduced on the Y-mill to 0.50-mm in four or five passes, depending upon coil hardness. Variations in primary manufacture of Thomas steel (basic bessemer) make uniform quality cold rolled products extremely difficult to achieve. For this first trial, the strip was precut to avoid incipient tears.

Despite inexperienced personnel, the mill yielded the expected results. The anticipated gage of 0.10 to 0.12-mm (0.0039 or 0.0047-in.) was attained.

Today on widths of 340mm (13.-3860-in.) the mill produces about 2000-2500 kg (4409-5511 lb) per hour. Most important production has been in Thomas steel, semi-finished stock of 2mm gage reduced to 0.50mm and the same roughs of 2mm finished at 0.11mm. Widths are between 300 and 400mm, (11.8 and 15.75-in.).

Annealing facilities in the plant consist of Ripoche bell-type electric furnaces with neutral gas obtained by cracking ammonia. The bells are designed to hold piles of coils with a maximum outside diameter of 0.75m (2.46 ft). Since the coils measure about 1.10m (3.6 ft) when they arrive from the mill, they are cut in two on the shearing line to fit under the bells. Sometimes intermediate annealing is necessary because of cracks which appear on the edges of the thin strip.

Coils weighing 1500 to 2000 kg are returned from the annealing furnaces in weights of 750 to 1000 kg. Since the gage is 0.50mm when the coils come from the furnaces, the length is sufficient to permit satisfactory rolling on the reversing Y-mill.

Through close collaboration with hot strip suppliers, Etilam is trying to eliminate intermediate annealing. The annealing causes considerable loss of time in the mill and adds to production costs.

A 400mm (15.75-in.) slitting shear specially designed for thin strip is now under construction. Arbors on which knives are mounted are idle, not driven. Strip to be sheared is drawn by the four puller reels, on which a maximum of eight strips are wound.

Hot rolled 0.13 per cent carbon steel is supplied to Etilam by the new continuous rolling mill of Providence Steel Works at Rehon. The Providence Steel Works until very recently were the only producers in France who could furnish 400mm wide strip, weighing 5 kg per mm width (300 lb-1-in. width). Steel is ordered in widths of 280mm (11.0238-in.) to 400mm (15.7483-in.).

But the Providence plant can provide only Thomas steels. This is a handicap for Etilam. Siemens, or basic open hearth, steel can be easily rolled without intermediate annealing. But unfortunately, no wide strip in basic open hearth steel is available.

To meet this cold-rolling difficulty Providence is now working on an improvement for its Thomas steels which should give them practically the same rolling and deep drawing properties as the Martin steels enjoy now.

The management of the Etilam mill has encountered a disadvantage in the utilization of the mill, because of the French price structure for hot rolled strip. The fact is that wide hot rolled strip costs more than the lesser widths. But the lesser widths cannot be purchased in heavy enough coils to be rolled at high speed in the reversing Y-mill. So, to get heavy narrow coils, Etilam has the additional expense of shearing the wide coils and at the same time paying more for them.

Etilam's principal markets for cold rolled strip are distributors of packing bands, manufacturers of Bergman and Kopex tubes for electric conductors, manufacturers of electric cables, automobile radiators and parts, weaving blades, shoe trees, metal labels, household articles; electrical appliances and cutters and stampers of washers.

Steel strip, plain or coated (tinned, galvanized, leaded, lacquered) is furnished by Etilam ready to use in the annealed state, cold-worked to the desired hardness, or quenched.

Figure 4 — French-designed shear is slitting steel into 8 strips. Knife arbors are not driven. Power is provided by pull reels.

Figure 5 — Annealing facilities consist of these Ripoche bell-type electric furnaces with an ammonia atmosphere.

FAIRLESS WORKS ORE AND COAL UNLOADERS

By LAIMONS NARUNS
Engineer, Crane and Bridge Dept.
Engineering Works Div.
Dravo Corp.
Pittsburgh, Pa.

▲ONE reason for selecting Morrisville, Pa., as the site for U. S. Steel Corp.'s giant new Fairless Works was economical water transportation on the Delaware River. Tidewater shipping to this plant will be advantageous in low costs because it will be possible to bring in by water the largest part of an estimated 5,400,000 tons of raw materials annually. Savings will also be made on freight charges for exported goods.

The dock is built on one side of a 350-ft wide boat slip which has sheetpile bulkheads on both sides and heavy foundations for material handling equipment on the dock side. The slip is 1000 ft long and 27 ft deep, and the northern end of it is left open for possible future extension. It is planned to deepen the slip to 40 ft after the upper Delaware channel is dredged to accommodate 35-ft draft ships.

When this is completed, ocean going cargo ships will unload imported ore not only for Fairless Works but also for other U. S. Steel plants. An estimated additional 3,500,000 to 6,000,000 tons of ore per year will be made available to these plants in the winter months when no ore moves on the Great Lakes.

One of the main foreign sources will be the "iron mountain" of Cerro Bolivar in Venezuela where there are an estimated 500,000,000 tons of rich iron ore.

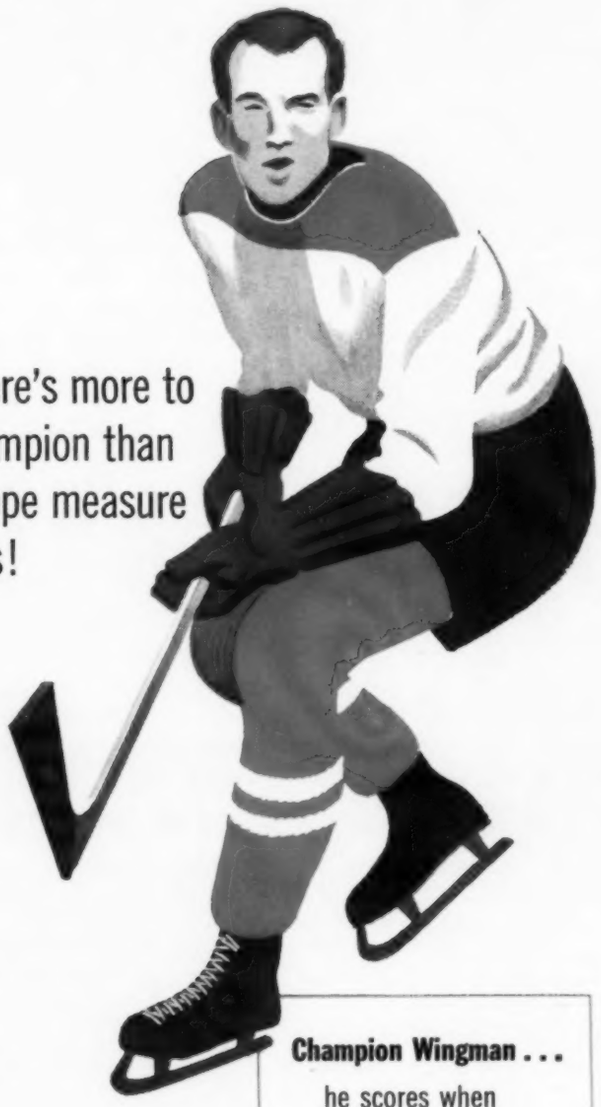
The material handling equipment at the new dock of Fairless Works had to be designed to meet anticipated future requirements. Dravo Corp., Pittsburgh, Pa., was awarded

Figure 1 — These two ore and coal unloaders at United States Steel Corp.'s giant Fairless works were designed and constructed by Dravo Corp. to meet anticipated future requirements for handling heavy imported iron ore, as well as to handle the present 150-lb per cu ft ore.

Figure 2 — Lower portion of the unloader gives ample clearance for three railroad tracks. Note the rear cantilever of the runway projecting 64 ft from the tower. The hopper cantilevered out from the rear of the tower feeds another conveyor. In all, there are four hoppers to receive raw material unloaded by this equipment.

IT'S PERFORMANCE THAT COUNTS

...there's more to a champion than the tape measure shows!



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Average Wingman . . . he may measure the same—but he's stopped in the close ones.

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Heppenstall Die Blocks perform like champions because they possess those extras that result in superior performance on the job. Their patented steel analysis resists softening and heat checking in service. Records from Plants using Hardtem Die Blocks prove the following benefits for production.

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★ **Reductions in Down Time**

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. . . the most dependable name in die blocks

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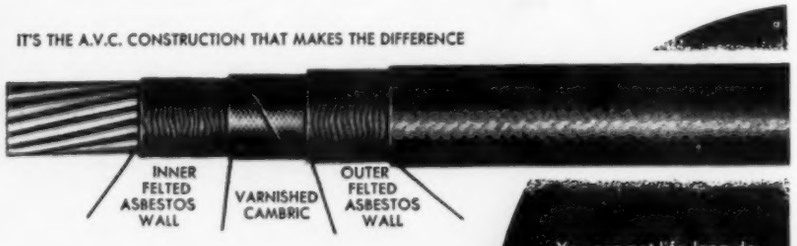
(N.E.C. TYPE AVA) POWER CABLE

IT'S THE A.V.C. CONSTRUCTION THAT MAKES THE DIFFERENCE



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You can safely and dependably use it in conduit for wiring around furnaces, ovens, soaking pits, boilers, etc. where temperatures run up to 230°F

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the contract for two man-trolley type unloaders with 15-ton capacity clamshell buckets. The two unloaders travel the full length of the slip on a common runway.

GENERAL DATA

The two unloaders are identical, each consisting essentially of a center tower section and a 267-ft long horizontal runway for a man-trolley. The front cantilever is designed for a bucket reach of 86 ft out from the front legs to unload ships of 108-ft beam planned for the future. A 65-ft long runway through the tower and a working travel of 64 ft 6 in. on the rear cantilever add to a total trolley travel of 215 ft 6 in.

The tower, 65 ft wide and 45 ft deep, is mounted on four eight-wheel trucks, one at each corner. The tower structure is built of rolled steel shapes. Its lower portion is constructed in the form of a portal to give ample clearance for three railroad tracks and a future conveyor belt between the tower runway tracks. The top of the portal supports four hoppers, one of which is cantilevered from the rear end of the tower to feed an ore conveyor belt now installed.

The upper part of the tower supports a machinery house of corrugated metal sheeting over a steel frame. In it is the apron hoist machinery. A lift beam with an 8-ton trolley service hoist runs across the house and extends out from one side to permit handling of machinery.

The upper end of the tower on the water side forms a mast for raising the runway apron. It supports a latch to secure the apron in raised position, and sheaves for apron hoist reeving. An anemometer is placed on top of the mast, highest point of the entire unit.

A system of walkways, stairs and ladders provides access to the unloader tower and runway. All walkways and platforms are fabricated from open-type steel grating. Ladders are provided with basket type safety cages made of expanded metal.

The minimum cubic and tonnage capacities of buckets and hoppers are based upon ore weighing 150 lb per cubic ft. However, many foreign ores weigh up to 200 lb per cu ft. Therefore, all structural, mechanical, and electrical parts were designed to handle equivalent volumes of ore weighing 200 lb per cu ft.

The main tower structure, the trolley runway, and the apron are of riveted construction, while parts such as the trolley, the apron hoist house, the trolley canopy, truck equalizers, and hoppers are of welded construction.

The unloader is operated on 230-v d-c electric power and full magnetic control is used throughout the entire electrical system.

MAN-TROLLEY

The man-trolley consists of a heavy welded steel frame which supports the mechanical equipment and a sheet metal house with two floors suspended beneath the trolley frame. On the top floor are electrical control boards and resistors for hoist and trolley travel. The lower room is the operator's cab and contains all master operating switches. These switches control the hoisting of the bucket, trolley travel and tower travel motions. The operator's cab is constructed to give the operator an unobstructed view for unloading operations.

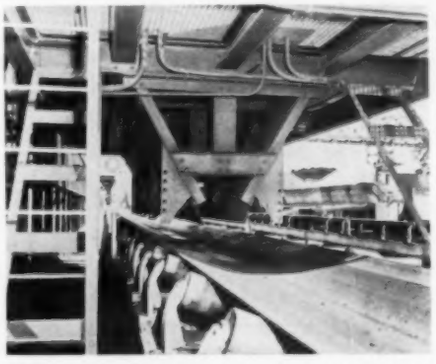


Figure 3 — The hopper that feeds this ore conveyor belt is cantilevered out from the rear of the unloader structure. Both unloaders are similarly equipped. The 48-in. conveyor belt is 3600 ft long and runs parallel to the ore storage yard.

The main members of the trolley frame are made of low alloy steel to minimize dead weight, and to increase strength and resistance to corrosion. The frame was completely fabricated before any machining was performed, thus providing the best possible foundation for alignment of the mechanical equipment. It is spring mounted on four 33-in. diameter tapered tread, single flanged wheels which were accurately machined and matched in pairs for each axle.

The two 125-hp trolley drive motors are mounted on welded steel cradles which are supported on antifriction bearings at two points on the trolley axle and on a third point through a flexible connection to the trolley frame. This arrangement allows for flexing of the supporting springs without misalignment of gearing.

The bucket is hoisted by two 250-hp motors. Each motor drives a cast steel drum with machined grooves of 34-in. pitch diameter for wire rope. The hoisting speed of the bucket is 250 fpm, while the trolley travel balanced speed is 1000 fpm. At these speeds, assuming a bucket hoist distance of 50 ft and a trolley travel of 60 ft, the unloader bucket is capable of making a round trip from ship's hold in 40 seconds. The unloader can be operated continuously at this rate and is theoretically capable of transporting 1350 net tons per hour of ore weighing 150 lb per cu ft when utilizing a bucket of 200 cu ft rated capacity and when digging in material of sufficient depth to assure rated load. The actual average capacity is lower because of time lost in clean-up operations of the boats, unloader movements, etc.

Each unloader is equipped with buckets of three sizes.

1. One ore bucket rated 200 cu ft or 15 net tons when digging ore weighing 150 lb per cu ft crushed to 2½ in. minus.
2. One coal bucket rated 400 cu ft or 10 net tons when digging run-of-mine coal weighing 50 lb per cu ft.
3. One ore bucket rated 120 cu ft or 9 net tons.

The smaller ore bucket is arranged to be used with a turntable which is installed in the trolley frame deck beneath the hoist drums and is of the direct-connected, bevel-gear drive type.

TROLLEY RUNWAY

The trolley runway consists of two modified Warren trusses, braced with transverse yokes at each panel point. These longitudinal trusses support 24 WF 100-lb runway beams, continuous 12 x ¾-in. cover plates and 105-lb rails for the man trolley. The rail stringers are canted inward on a slope of 1 in 40, in order to put the wear surface at the center of the rail head.

The front cantilever is of a hinged apron type and can be raised to clear a ship's rigging while moving along

the dock. It is 105 ft long and suspended in the lowered position on two sets of linked eyebars.

The apron is automatically latched securely in its fully raised position when the unloader is not in use or left unattended. During regular working periods the apron is usually raised only to a position where it clears any possible interference and is held by the lifting ropes.

The machinery house on top of the tower shelters electrical control panels and resistors for the tower travel motors as well as apron hoisting machinery. The apron hoist is operated by a 65-hp motor equipped with electric brake through spur gear and worm gear reductions. The welded drum is grooved to receive all of the rope in one layer.

The apron hoist can be operated at two positions by means of duplicate controls. One set of controls is located at the apron hoist house and the other is placed at the level of the trolley runway. However, the release of the safety latch, which is accomplished by means of a hand-powered winch, is confined to the upper location only.

The apron hoist control is interlocked with trolley travel control so that apron hoist motors cannot be energized when the trolley is on the apron. The single hoist drum has a 50-in. pitch diameter and the reeving consists of two one-in. diameter ropes which are connected with one end to the drum, each reeved seven parts over 33½-in. outside diameter sheaves, and with the other ends connected to a bar type equalizer on the apron. The raising of the apron requires 5½ minutes.

Low alloy steel of relatively high strength and corrosion resistance (Tri-Ten) was used in apron trusses and cross frames to minimize the dead load of the apron.

The construction of the tower runway and the rear cantilever is similar to the apron except that the rear cantilever is supported by a fixed structural hanger. Structural carbon steel is used throughout in these portions of the runway.

At both ends of the runway spring buffers with a stroke of 20 in. are provided for emergency stopping. These buffers were designed to absorb the full energy of the trolley when traveling at 50 per cent balanced speed without the lifted load. An additional movable buffer is provided at the water leg of the tower to stop the trolley when the apron is in raised position. This spring buffer is lowered across the trolley track by the action of raising the apron. Thus, the trolley may be used safely for reclaiming material from the storage area under the rear cantilever also when apron is raised.

HOPPERS

The lower part of tower supports four hoppers. The front hoppers, A and B, are placed above two parallel railroad tracks that run along the dock. They are equipped with 48-in. x 48-in. undercut gates which are independently motor operated and feed ore to railroad cars through discharge chutes. The two hoppers are alike, each having a capacity of 101 tons of ore (150 lb per cu ft), a top area of 16 x 25 ft, and minimum corner slopes of 43 degrees. The elevation of these hoppers was set as low as possible consistent with top deck area required for bucket discharge, valley slopes, type of gate used, and 23-ft clearance for railroad cars.

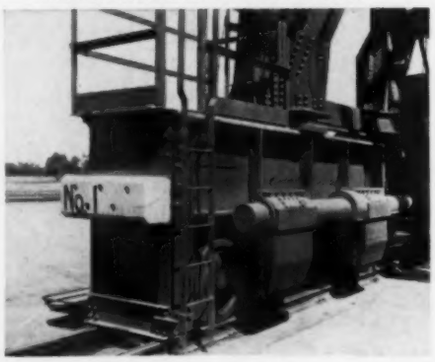
The two rear hoppers, C and D, have feeders over conveyor belts. Hopper C is for coal only, but was designed for 200 lb per cu ft ore so that it could be used for ore if necessary. Hoppers C and D are alike except for a baffle across the top of hopper D which is located over the ore belt outside the rear tower legs. The baffle cuts down the ore storage capacity and thereby reduces the load on the rear legs of the tower. Hopper C has a rated capacity of 47 tons of coal and hopper D of 120 tons of 150 lb per cu ft ore. They both have top area of 18 ft x 25 ft and minimum corner slopes of 46 degrees.

All four hoppers are made of ⅜-in. shell plating suitably stiffened and lined with ⅜-in. abrasion resistant steel.

The rear cantilever of the runway provides for a bucket travel of 64 ft 6 in. beyond the landward legs of the tower. With this travel, ore can be taken directly from the ship to temporary storage in a concrete floored trough having a capacity of 60,000 tons. From here, it is handled by an ore bridge which transfers material either to the ore storage yard of 750,000-ton capacity or to an electrically heated storage hopper from where ore is discharged into electrically operated, double side dump transfer cars used for stocking blast furnace bins.

The belt conveyor under the cantilevered rear hoppers of the unloaders is 48 in. wide and 3600 ft long. It runs parallel to the boat slip and ore storage yard and carries ore to the blast furnaces.

Figure 4 — Eight-wheel trucks located at each corner of the unloader are equipped with rocker bars and equalizer beams to distribute the load uniformly over all wheels. One 33-hp motor drives all wheels through worm gear and spur gear reduction units to each axle.



TRUCKS

The unloader travels on tracks 65 ft center to center which are formed by double rails on 2-ft 6-in. centers. Design of the 8-wheel unloader travel trucks at each corner of the tower involves a variety of conditions which result in a wide range of possible wheel loads. Among these conditions are location of man-trolley, amount of material carried by man-trolley, apron up or apron down, amount of ore and coal in hoppers, wind, travelling condition, etc.

The load is fully equalized over all wheels by a system of rocker bars and equalizing beams. The wrought steel single-flanged wheels are 30 in. in diameter with flat treads which are rim toughened.

Each corner is driven independently by one 33-hp motor driving through worm gear and spur gear reduction units to each axle. The worm gear reductions are connected to the motor by universal joints. A friction coupling is used between the two worm gear units with each individual worm set having the ability to transmit momentarily the full starting torque of the motor. Each worm wheel and spur pinion is mounted on a common shaft. One spur pinion drives two gears which, in turn, drive two wheels on a common axle. Pro-

World's Largest Builders of World's Largest Cranes

Alliance...

FIRST IN SIZE! FIRST IN CRANE DESIGN!

LOOK AT THE FEATURES OF THIS NEW CRANE!

- **Working parts easily accessible for quick maintenance.**
- **Adequate end bracing and large gusset plates keep crane square and girders plumb.**
- **Liberal safety factors . . . girders, ropes, bearings, gearing, motor sizes.**
- **Sealed lubrication on all roller bearings.**
- **Enclosed controls keep out mill dirt and, as located on foot walk, provide maximum accessibility.**
- **Operation easily and accurately controlled. Operator's cab located at center of bridge gives best visibility.**
- **One-piece welded trolley frame.**
- **All-steel construction including cast steel drums.**

For over half a century leading mill designers and builders for heavy industry have turned to The Alliance Machine Company for dependable heavy-duty cranes. Alliance has constantly pioneered mechanical features which are accepted today as conventional. Alliance can develop equipment best suited to your company's particular heavy material handling needs. Write for full information.

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Alliance Standard Steel Mill Crane in the Cold Strip Reduction Department of the Fairless Works, U. S. Steel Corporation. This standard overhead crane has a 100-ft. span, with a 90-ton main hoist and 30-ton auxiliary hoist.

visions are made to limit the drop of any truck to one in. in case of axle breakage.

RAIL CLAMPS

Rail clamps are a highly important safety feature. Two automatic rail clamps of Dravo design are used on each side of the tower. These clamps have sufficient grip on the rails, using 30 per cent coefficient of friction between the jaw of the clamp and the rail, to hold the unloader structure against a maximum wind pressure of 40 lb per sq ft without benefit of other devices. The gripping force for each clamp is furnished by the action of helical springs through a toggle and lever arrangement which greatly multiplies the spring force. The arms of these clamps are made of cast steel with jaw inserts made of hardened steel for engaging the rail. The whole clamp construction is simple. The only parts requiring attention are the teeth of the jaw inserts which can be resharpened or replaced.

The clamp is released by a system of ropes reeved about sheaves in the clamp arms and attached to a drum in the release mechanism. One motor operates two welded steel drums. It has a magnetically set spring release brake to stop the motion of the clamp arms upon reaching their release position.

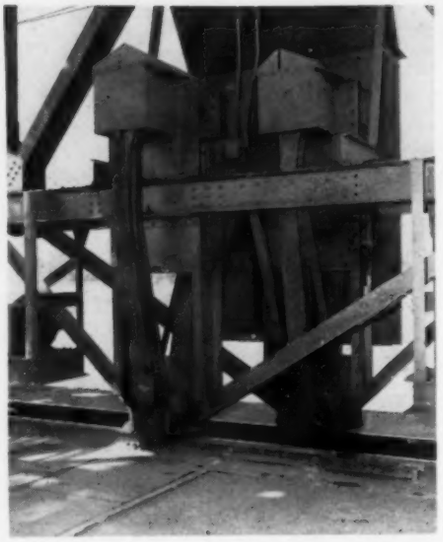


Figure 5 — Automatic rail clamps of Dravo design are an important safety feature of the unloaders. The clamps hold the structures against wind pressure of 40 lb per sq ft. They grip the rail by the action of helical springs through toggle and lever arrangement illustrated here.

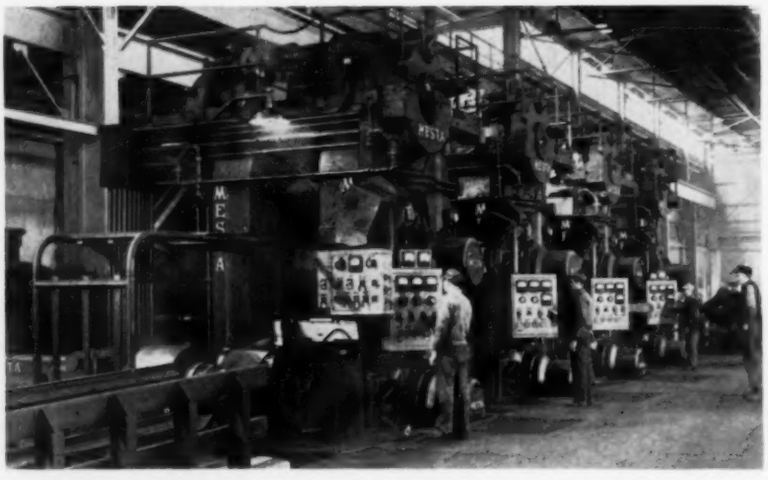
The anemometer arrangement consists of a Burton wind-cup generator and a direct reading recorder, complete with a panel to cut out tower travel when wind velocity exceeds 38 mph. At the same time a motor driven siren is actuated to sound high-wind alarm, and rail clamps are automatically set. The controls for the rail clamp motors are interlocked with the bridge travel motors so that the rail clamps also are set automatically in case of a power failure and at all times except when bridge travel motors are operating.

The entire weight of the clamp is carried on the supporting structure so that the clamp never slides on the rail, and there is ample clearance between the jaws and the sides of the rail head when the clamp is released.

These unloaders are modern high speed machines which not only will meet present needs but also will unload spedily and efficiently the huge ore ships of the future which will navigate the Delaware channel, when deepened, bringing ore to Fairless Works.

WORLD'S FIRST
VALVOLINE
MOTOR OIL

One of the many large mills
at ALLEGHENY LUDLUM STEEL CORP.,
West Leechburg, Penna.
lubricated by VALVOLINE



Tandem Mill

Four High — Four Stand

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DIVISION OF ASHLAND OIL & REFINING CO.

G-E LIMITAMP controls the operation of high-voltage motor drives up to 2250 hp . . . gives you quick, silent protection for personnel and equipment against dangerous short-circuit conditions up to 250,000 kva . . . helps prevent costly shutdowns.

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Don't take chances with dangerous short-circuit conditions. G-E Limitamp Control protects against sudden electrical overloads . . . assures greater safety for your personnel and costly electrical equipment. A high-voltage motor control, G-E Limitamp Control provides interrupting capacity up to 250,000 kva.

MAINTENANCE PERSONNEL is guarded by a steel barrier separating high- and low-voltage compartments. A mechanical door interlock assures motor circuit interruption before the fuse compartment door can be opened.

GET EQUIPMENT PROTECTION with General Electric Type EJ-2 fuses which clear fault current in less than ¼ cycle, operate only under actual "short" conditions. Also, improved heavy-duty air-break contactors give you millions of operations.

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MAINTENANCE IS EASY . . . Fuses swing forward on hinges for the disconnect position and fuses can be quickly lifted out.

You can put your confidence in—

GENERAL ELECTRIC

We "planted" it in wartime

Two years ago next month we broke the news about "the palm tree that grows in Ohio" — Palmoshield, the domestic replacement for imported palm oil.

Users at this writing include most of the major tin plate producers of this country and Canada. They have found that Palmoshield, being a scientifically formulated product, is much more stable and uniform than the natural oil. In use it has helped increase tonnage as much as 15%. More important, it eliminates many of the variables which can prevent rolling clean, high quality steel.

...it flourishes in peace!

Today, the picture in steel is changing. With the pressure of production easing, increasing emphasis is placed on quality, on problems of finish and efficiency in operation.

Ironsides research, which developed Palmoshield, is now geared to these problems of the future. The same facilities which freed the industry from dependence upon foreign lubricants can now be focused on specific plant lubricating questions. Our engineers are available for consultation and technical assistance without obligation. Call or write Director of Research, The Ironsides Company, 270 West Mound Street, Columbus, Ohio.

Special Lubricants and Preservatives

SHIELD PRODUCTS **IRONSIDES PALMOSHIELD**

"the palm tree that grows in Ohio"

By MAXWELL L. BIBLE, Roll Oil Technician, The Brooks Oil Co., Pittsburgh, Pa.

A MULTI-PURPOSE ROLLING COMPOUND

▲COLD reduction of steel and other metals has always been a severe problem in lubrication requirements. A desirable lubricant should provide the maximum in gauge reduction with minimum power input, negligible damage to rolls, high surface speed, ultra-high finish, low temperature rolling practice, a minimum of cooling water, clean surfaces and economical costs of the lubricant and application.

Palm oil was probably the first product used, and is not to be disregarded because of the good rolling performance which has been attained. While still in use, various unfavorable factors or characteristics have stimulated the development of an improved product, particularly to satisfy increasing changes in metallurgical and rolling practice demands.

Sections of the petroleum industry have with laboratory research, prolonged experiments, and costly expenditures, produced compounded lubricants with highly improved characteristics and rolling accomplishments. Believed an outstanding accomplishment is "Rollene H" as manufactured and submited for wide range rolling practice. This is a product which can increase gauge reductions with substantial decrease in lubrication and conditioner or cleaner requirements. These latter are important considerations. The new lubricant has produced these results in numerous difficult rolling operations.

Accomplishments of noteworthy nature have been in the application of this lubricant after the pickling operation, and then rolling the material with nothing but water on the mill for cooling. In such applications, it has not been necessary to use any other roll lubricant or conditioner on the mill, whether a single stand or a 2 to 5-stand tandem type.

When applying after the pickling operation, the quantity required has been one and one-half pounds or less per ton as a coating in the form of a thin film. This has proved to be sufficient to prevent corrosion and frictional disturbances on 60,000 to 80,000-lb coils without any ill effects in coiling or uncoiling. With this single application, the material is cold reduced by the mill without additional lubricant or cleaner. In this application, the temperature of the lubricant has been from 200 to 220 F with other procedures normal.

With adequate rolling power, the lubricant provides sufficient lubrication to cold reduce killed or rimmed steel with over 80 per cent reduction on a 3-stand tandem mill; 87 per cent reduction on a 4-stand tandem mill; and 91 per cent reduction on a 5-stand tandem mill. Similar accomplishments have also been attained on reversing mills of various types under normal rolling conditions.

The new lubricant eliminates the use of roll lubricants and emulsion cleaners on the mill or rolls, dissipates the heat generated by internal deformation of metal by water cooling only, and decreases power consumption even when making greater reductions. Roll life or service, particularly with shot blasted rolls, has in many cases been extended 100 per cent between redressings. This is a factor of importance in mill rolling costs. The thin carry-through film applied at the pickler, serves as a rust preventive coating prior to the annealing operation, and as a light dry coating. It will not cause staining of metal or form a film deposit on the temper pass rolls. Back up and work rolls are clean at all times and will not corrode with the lubricant film serving as a protective coating except for the period of time after the rolls have been redressed. From the small quantity required at the pickler, and by its inherent nature from compounding, there are no reclaiming or sewer clogging problems nor contamination to coolant water. A reduction in labor costs is accomplished by elimination of the necessity of mixing roll lubricants and emulsion cleaners together and by elimination of messy conditions which can also become a fire hazard.

The lubricant eliminates electrolytic cleaning prior to annealing for terne plating, electro-galvanizing, hot dip galvanizing, copper plating, and painting operations. The carry-through film coverage on the rolled metal completely volatalizes at sub-annealing temperatures, leaving a light dry coating between the sheets as an aid to prevent sticking of light gauge sheets or coils.

Physical characteristics in general, are similar to, but far superior to palm oil. These are: high cold test, low viscosity, non-corrosive, affinity to metals, water repellent, low organic acidity, negligible carbon residue or smudge, does not increase in acidity, stability in storage and service, readily mixes with petroleum oils and is applicable for rolling ferrous and non-ferrous metals. It is possible to dilute this product, but the amount and type of diluent will depend on the grade of metals and practice in the rolling operations.

From the performance of this product in rolling with greater reductions in the United States and Canada, a practice is being developed of adopting one to two in substitution for four to six hot band gauges to roll 85 per cent of all sheet gauges. For example: with 0.090-in. hot band gauge, it will be possible to roll all gauges from 0.014-in. to 0.041-in. and with 0.015-in. hot band gauge to roll all gauges from 0.020-in. to 0.054-in. This will accomplish the rolling of increased tonnage from the hot mill and pickler operations at lower cost production per hour and without increasing the cold mill conversion costs.

"Rollene H" may be considered a multi-purpose rolling lubricant and is manufactured to exacting chemical specifications from highly refined and available domestic materials. Manufacturing procedure control is by a trained and experienced technical staff. Field or service requirements are with technical and practical personnel having many years of experience with roll lubricants for cold rolling all types and grades of ferrous and non-ferrous metals.

ONLY a few years ago, the science of sensitive, accurate measurement was limited to laboratories. But today, this science is practiced every day in thousands of industrial plants by factory men . . . who don't have to be instrument experts.

Production men wanted to put this science to work, for they had long known that many processes would function at greater efficiency if temperature, pressure and other variables could be more accurately maintained. Although these potential benefits could be proved in the laboratory or in pilot plants, they could seldom be exploited fully in actual production.

Milestone in measurement

One of the main reasons was that existing industrial methods of measurement were not sufficiently accurate, sensitive or fast. Instruments with delicate mechanical balancing systems suffer inherent limitations . . . always require a compromise between sensitivity and ruggedness . . . and can provide only periodic measurements.

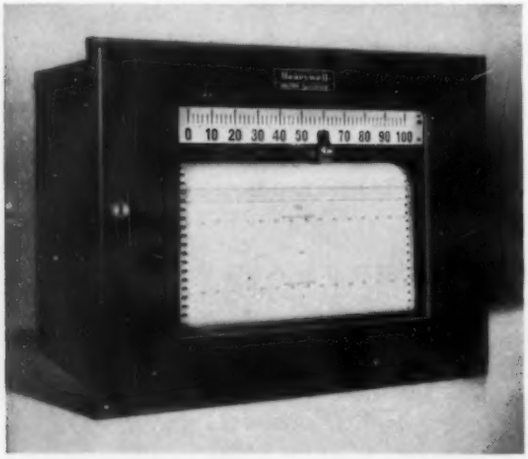
Then, in 1940, the advent of *ElectroniK* instruments swept away these limitations. By adopting an entirely new approach—electronic continuous balancing—these instruments revolutionized the concepts of industrial measurement. They placed laboratory accuracy and sensitivity at the disposal of the production man . . . with all the simplicity and ruggedness demanded by industrial service . . . *plus* speed of response never before economically practical.

Proved by years of performance

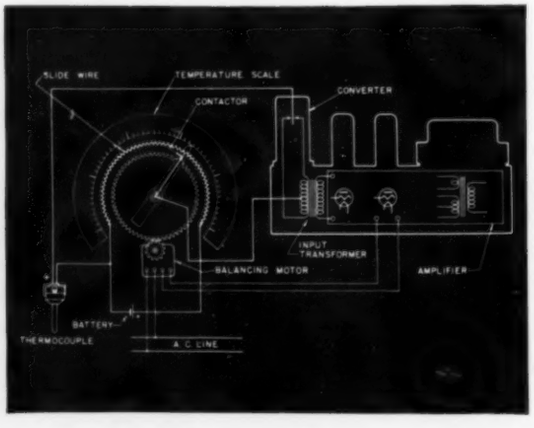
In the past thirteen years, thousands of plants have discovered almost endless applications where the superior performance of these instruments helps to improve operations. The more they learn about *ElectroniK* instruments, the more they call on them for increasingly complex tasks of measurement and automatic control.

Since 1940, the *ElectroniK* family has grown to encompass a host of new indicating, recording and controlling models . . . capable of measuring scores of different process variables . . . equipped with the most advanced types of automatic control. In anticipation of the needs of the future, Honeywell's intensive development program is bringing to readiness even more advanced equipment for tomorrow's process control problems.

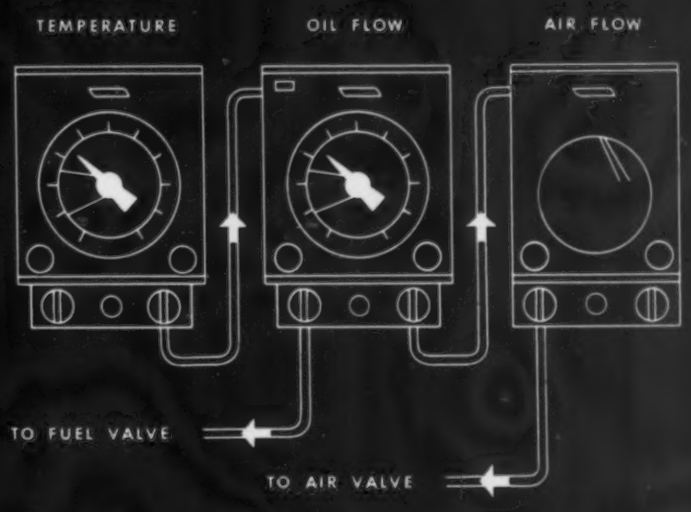
Versatile *ideal*



A FAMILIAR SIGHT *to thousands of production men, scientists and engineers is this strip-chart* ***ElectroniK*** *Recorder, one of a complete family of indicating, recording and controlling instruments.*



POWER PLANT *of* ***ElectroniK*** *instruments amplifies a millionfold the minute electrical signals from thermocouples and other sensing elements.*



Typical three-instrument interlocked control system for temperature and fuel-air ratio, utilizing *ElectroniK* Flow Meter.

ElectroniK flow meter—
for fuel-air ratio control

HERE'S an instrument that fits readily into integrated fuel-air ratio control systems . . . and is really versatile as an individual fuel flow controller. It indicates, records, integrates, retransmits to a remote indicator, and resets its own control index from a remote controller to which it is interlocked.

The *ElectroniK* flow meter saves panel space, because it concentrates all these functions in a single instrument case. Measurements are made completely electrically, by an ample-powered servo system that takes no driving power from the primary element . . . operates control and retransmitting devices at unimpaired speed and sensitivity.

A fast, accurate counter adds up oil or gas flow, to aid in fuel cost accounting. In ratio control, a fixed or adjustable *Indexet* sets the control index from a remote transmitter. Electric transmission from the remote meter body spans any distance . . . provides instantaneous measurement. Meter body can be linear, square root, or area type.

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First in Controls

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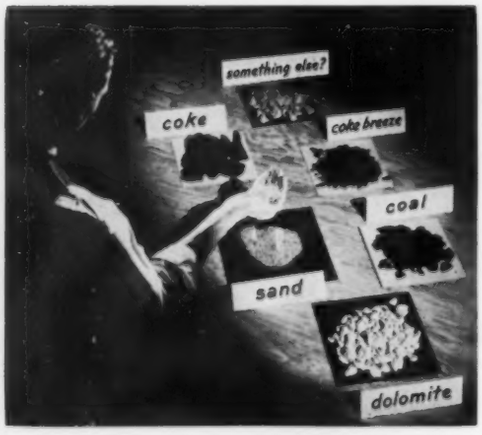

Whatever bulk material is giving you handling headaches or processing problems—coal, coke, coke breeze, sand, dolomite or some other—there's a simple, effective way to solve the problem: PUT IT UP TO US.

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CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

"Cities Service Chillo Cutting Oil Has Proved To Be The Difference Between Ordinary And Quality Production In Our Shop!"

Here's Atlantic Automatic's story in their own words: "One of our tougher jobs recently was machining SAE 446 Stainless Steel with two forming, one threading and three drilling operations. The critical operation was drilling a .025 inch diameter hole, ⅛ inch deep. The drill would soon pack with chips and break. When a Cities Service Lubrication Engineer was called in, he recommended our using Chillo 44.

"This light-colored oil did the trick. DOWN TIME WAS CUT IN HALF AND DRILL LIFE INCREASED OVER 200%!

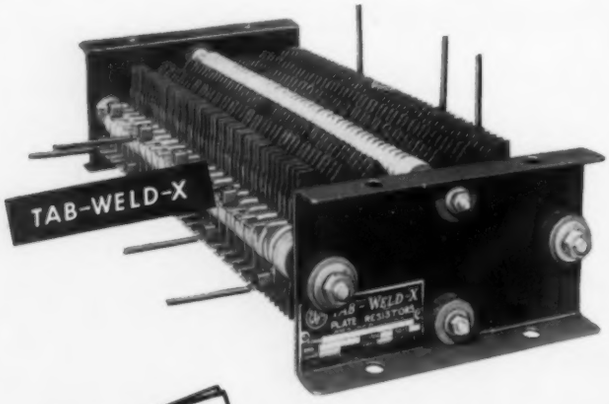
"We use Cities Service Chillo 44 to machine all types of metals covering a range of machinability from brass to stainless on our Brown and Sharpe 00G, 0G and 2G Automatics. It has proved to be the difference between ordinary and quality production in our shop!"

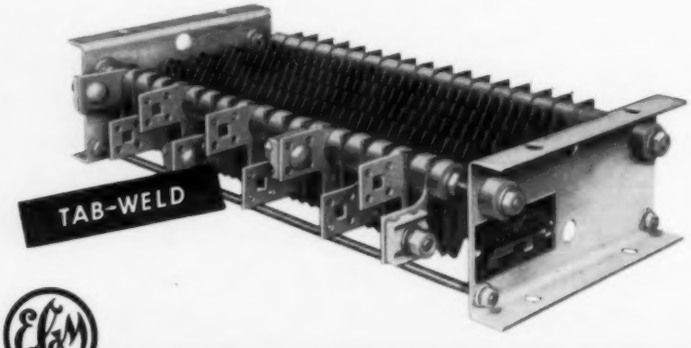
low priced yet...it includes Preventive Maintenance

"F. O. B." *(FREE-OF-BURNING)*

Resistors get little attention, because they are usually mounted overhead or in similar hard-to-reach locations. Clamping-nut pressure slackens under alternate heating and cooling. Formerly, under the reduced pressure, OHMIC value changed, burning occurred and often was *not* noticed until damage took its toll.

But — note how resistor troubles are now eliminated in the **EC&M TAB-WELD** design! The current-carrying path is continuous — and is ***independent*** of end clamping-nut pressure. Convenient tap-plates simplify tap-shifting—make possible small adjustments in resistance value, because plates are closely spaced. Also, these alloy-steel resistors are corrosion-resisting—and have negligible resistance-change between cold and maximum working temperatures.





SPECIFY BULLETIN 942 **EC&M Welded Plate Resistors**

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

10 days

OR...

50 weeks

THE SERVICE RECORD . . still incomplete—of these steel mill straightening roll idlers is not presented as typical of *all* Stoody Castings. While our experience indicates that Stoody non-ferrous centrifugal castings normally show a service life 5 to 10 times that of standard parts, these particular idlers are giving an even more extraordinary performance. Stock tempered steel idlers in this operation customarily last 6 to 10 days; *latest reports on the present castings show 50 weeks service with very little wear!* These castings, at a cost of approximately $750.00 each, paid for themselves in the first 9 weeks.

For operations to which Stoody Castings are adaptable—*where severe wear is a major factor, where high operating temperatures and corrosion may present problems or where lubrication might be difficult*—Stoody Castings frequently provide an economical solution through reduction of down-time, lost production and parts replacement. Current uses of Stoody Castings include such parts as steel mill guide rolls, sewer pipe die rings and cores, extrusion cylinder liners, bushings and bearing surfaces, ball valve seats, wire flattening rolls and parts for mechanical seals.

A booklet describing these castings will be sent at your request. Our technical staff is placed at your disposal in determining the adaptability of Stoody Castings to your own requirements.

STOODY COMPANY

11942 EAST SLAUSON AVENUE
WHITTIER, CALIFORNIA

BLAST FURNACE STOVE CLEANED IN TWO DAYS

Heating efficiency increased 30% by Dowell Chemical Cleaning

Flue deposits that accumulate on the checkerworks of blast furnace stoves need not halt iron production! Stoves with heavy deposits have been cleaned in two days by Dowell—while the other stoves carried the heating load to avoid shutdown.

To clean their stoves, *and keep them clean*, many operators rely on Dowell chemical cleaning service. That's because Dowell's record for service work of this kind is outstanding in the industry. On one job, for instance, chemical cleaning by Dowell helped raise the gas heating efficiency of a blast furnace stove from 63.6% to 82.7%. What's more, the cleaning was accomplished *in two working days without dismantling the stove!* Dowell Service engineers used a high-pressure solvent jet, which combines chemical and hydraulic action to clean the brick checkerworks.

Dowell engineers are experts in cleaning industrial equipment with solvents. Almost every piece of equipment found in a blast furnace gas cycle has been cleaned by Dowell . . . some while in operation.

Whatever your problem, look to Dowell chemical cleaning service for the practical answer. For complete information, call your nearest Dowell office. Or write directly to Tulsa, Dept. L-29.

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DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Date-line Diary...

November 2

▲ The AISI reports that operating rate of the steel industry for the week starting November 2 is scheduled at 92.9 per cent of capacity. This is equivalent to 2,094,000 tons compared with 2,132,000 tons one week ago.

▲ The Commerce Dept. estimated employment in October had dropped about 65,000 below September, but the total employed figure was close to October, 1952.

▲ The Commerce Dept. has revoked NPA's regulatory measure titled "Designation of Scarce Materials 1" as officials feel continuation of this designation no longer is warranted. This covered chromium, cobalt, columbium, tantalum, molybdenum, and nickel.

November 3

▲ Personal income hit an annual record of $284,000,000,000 in the first nine months of 1953, 6½ per cent ahead of the period in 1952, according to the Commerce Dept.

November 4

▲ W. J. McNeil, Pentagon budget chief, announced defense spending is still on the upswing but will head down in December. No sharp changes in military expenditures are planned.

▲ Oil demand during October dropped 4 per cent from October 1952 according to John S. Herold, Inc., geologists. This is the first month this year that this occurred.

November 5

▲ To increase employment opportunities, defense mobilizer Flemming announced tax write-offs will be allowed on up to 100 per cent of outlays for defense production facilities in areas where employment is low.

November 6

▲ Inventories of manufacturing, wholesale and retail firms climbed to a record $78,700,000,000 in September, about $5,700,000,000 above one year ago. September business sales dropped $700,000,000 below the August total of $48,200,000,000.

November 9

▲ The AISI reports that operating rate of the steel industry for the week starting November 9 is scheduled at 92.8 per cent of capacity. This is equivalent to 2,092,000 tons compared with 2,096,000 tons one week ago.

▲ Chrysler Corp. sold 1,024,978 cars and trucks in the first nine months, compared with 769,113 a year earlier. Profits dropped from $6.86 a share in 1952 to $6.40 in 1953 for the nine month period.

November 10

▲ Secretary of the treasury, Humphrey, stated U. S. Government faces an $8,000,000,000 or $9,000,000,000 deficit in 1954-55 if spending keeps at its present pace.

▲ Layoffs have been rising since mid-year from the low rate of 1952 and first half of 1953, as reported by the Bureau of Labor Statistics.

▲ According to the ARCI, deliveries of new domestic freight cars in October totalled 8727, a new high for 1953, as compared with 5706 in September and 5437 in October 1952. Orders in October totalled 1705 cars. Backlog of cars on order as of November 1 was 35,171.

▲ The Aluminum Association announced a total primary production of aluminum for September of 218,666,531 lb as compared with 221,090,007 lb in August and 153,764,606 lb in September one year ago.

November 12

▲ The Pittsburgh Steamship Division of U. S. Steel Corp. proposes to sell the five smallest ships of its 64-vessel fleet.

▲ By the end of November, Kaiser Motors Corp., will halt production of cars at its large Willow Run Plant which it has sold to General Motors Corp. for $26,000,000. Kaiser operations will be confined to plants of its Toledo subsidiary, Willys Motors, Inc.

▲ Hallicrafters-Chicago, Inc., Raytheon Manufacturing Corp., and Westinghouse Electric Corp. made reductions in the price of certain models of their television sets.

November 14

▲ The official opinion of F. W. Dodge Corp. is that construction in the 37 states east of the Rockies will decline only 3 per cent in 1954 as compared with 1953.

▲ The Commerce and Labor Depts. estimate building expenditures in 1954 at $34,000,000,000, 2 per cent lower than the total expected for this year.

▲ The Commerce Dept. reported national production of goods fell slightly in the third quarter, the first time in 3½ years, with a total output of $369,000,000,000 which was $3,500,000,000 below the preceding three month period.

▲ According to the AISI, average hourly wages rose to a high level in September of $2.328, or 1 per cent above August, and 12.2¢ above September 1952. Total payroll for September is estimated at $283,773,000 compared with $287,253,000 in August and $269,391,000 in September 1952. Total employment was 687,000 in September working an average 39.2 hours per week.

November 16

▲ The AISI reports that operating rate of the steel industry for the week starting November 16 is scheduled at 91.3 per cent of capacity. This is equivalent to 2,057,000 tons compared with 2,081,000 tons one week ago.

November 17

▲ State authorities ruled that output of crude oil in

Texas must be reduced by 65,854 barrels daily. This is the fourth consecutive monthly cut.

▲ Ralph J. Cordiner, president of General Electric Co., stated the company's sales this year will top $3,000,000,000. The previous high was $2,600,000,000 reached in 1952.

▲ Directors of Lukens Steel Co. declared an extra year-end dividend of $1 per share.

▲ F. W. Dodge Corp. announced the total of construction contract awards at $14,749,649,000 was up 5 per cent at the ten month mark in the 37 states east of the Rockies compared with the same period in 1952.

November 18

▲ Directors of The Youngstown Sheet and Tube Co. declared an extra dividend of 75¢ a common share.

▲ Republic Steel Corp. raised their quarterly common dividend from $1 to $1.12½ and declared 37½¢ extra.

▲ At its Cleveland convention, the CIO approved a 2-year pact to outlaw inter-union membership raids.

▲ Operations of Jones & Laughlin's Aliquippa Works were cut off as a result of a strike by about 750 employees of its Aliquippa & Southern Railroad Div.

November 19

▲ Inland Steel Co. renovated one of its three blooming mills at its Indiana Harbor, Ind. works. A loss of 23 days and a production loss of 100,000 tons was the result of this changeover.

▲ Jones & Laughlin has shut down four open hearths in No. 2 shop at its Pittsburgh works. Two weeks previous to this, the company idled five other furnaces in this shop and a blast furnace.

▲ Republic Steel Corp. shut down one of its two blast furnaces at their Gulfsteel, Gadsden, Ala. plant which idled 100 men.

▲ Working hours of Jones & Laughlin's supervisory personnel will be gradually reduced from the present 44-48 hr week to 40 hr eliminating some overtime.

▲ The new Lock No. 2 on the Monongahela River, built by Dravo Corp., was dedicated. The structure cost $17,200,000 and required 4½ years to build.

November 20

▲ As reported by the Association of American Railroads, loadings dipped to 727,058 cars last week which was 2.8 per cent below the preceding week, and 12.3 per cent below the same week in 1952.

▲ The Engineering News-Record reported heavy construction contracts awarded for the week ending November 16 totaled $245,000,000, down 10 per cent from this period in 1952. This brings the total to mid November 1953 to $13,500,000,000, down 7 per cent from a year ago.

November 23

▲ Directors of Allegheny Ludlum Steel Corp. declared a 2 per cent common stock dividend as a year-end extra to holders of common stock. A 50 cent cash dividend was also declared.

▲ The AISI reports that operating rate of the steel industry for the week starting November 23 is scheduled at 87.6 per cent of capacity. This is equivalent to 1,974,000 tons compared with 2,044,000 tons one week ago.

November 24

▲ Straits tin jumped 1¾¢ to 85¾¢ a lb in New York. Tin price has advanced 3¾¢ a lb since November 16.

▲ Machine tool makers' orders for October dropped to $59,000,000 down 11 per cent from the preceding month and 17.7 per cent less than October 1952.

▲ According to the Securities and Exchange Commission, U. S. corporations sold $1,600,000,000 worth of new stocks and bonds in the third quarter of 1953, down 27 per cent from one year ago.

▲ Allegheny Ludlum announced a price increase of 7½¢ to 25¢ a lb on cobalt-bearing high temperature steel alloys, effective December 1.

November 25

▲ Air Force and industry spokesmen have tried to increase production of titanium for use in super-sonic planes. The military wants a titanium output of 35,000 tons annually, and contracts awarded now cover only about 13,800 tons.

▲ Union Drawn Steel Co., Ltd. of Hamilton, Ontario, a subsidiary of Republic Steel Corp., has purchased over 1100 acres of land at Embro, Ont., containing high quality limestone. Deposit is sufficient to supply Republic for several generations.

▲ U. S. Steel Corp. placed its No. 4 blast furnace back into operation at its Duquesne, Pa. works. Furnace has a daily capacity of 950 tons iron. It has been down since May 28.

November 30

▲ U. S. Steel Corp. will begin construction of a plant for producing steel drums and pails for petroleum, chemical, paint, food and other industries at Pennsauken Township, N. J. It will occupy a 26.7 acre area and will have 168,000 sq ft of floor space. Plant will be operated by U. S. Steel Products Div.

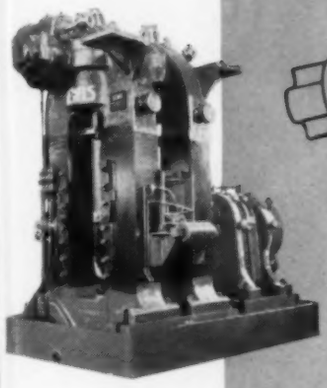
▲ Jones and Laughlin will close three large coal mines in Pennsylvania due to the railroad strike which has affected its Aliquippa Works.

▲ The AISI reports that operating rate of the steel industry for the week starting November 30 is scheduled at 86.8 per cent of capacity. This is equivalent to 1,956,000 tons, the same as one week ago.

▲ The American Institute of Steel Construction reports October shipments of fabricated steel amounted to 289,755 tons, the highest figure since 1929. Bookings during October were 191,180 or a decrease of 12 per cent from September but up 4 per cent above October 1952. Backlog of work ahead as of October 31 stands at 1,927,240 tons.

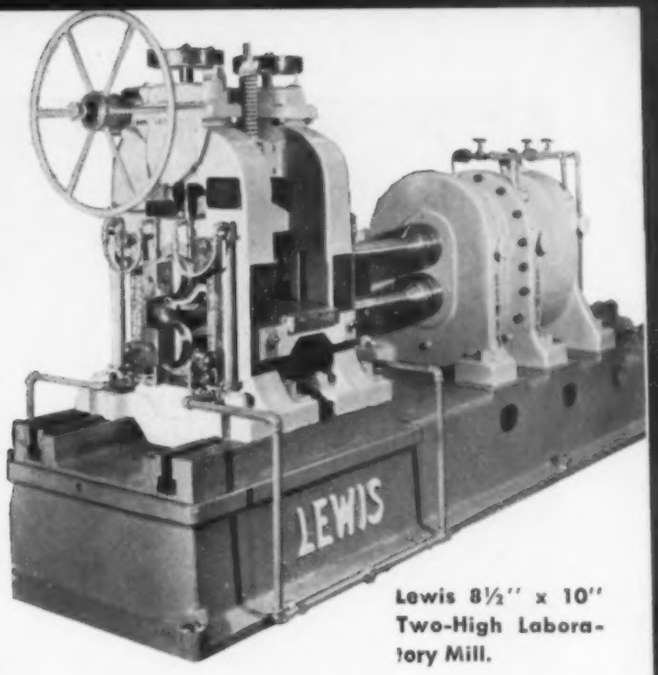
▲ Republic Steel announced it would put in effect on December 15, a simplified pricing system under which it will quote nothing but delivered prices for hot rolled bars. System will be later extended to other products.

▲ Lukens Steel announced a price reduction in carbon and alloy steel plates effective December 1, 1953. New prices are $4.20 per 100 lb for carbon and $5.55 per 100 lb for alloy plates.

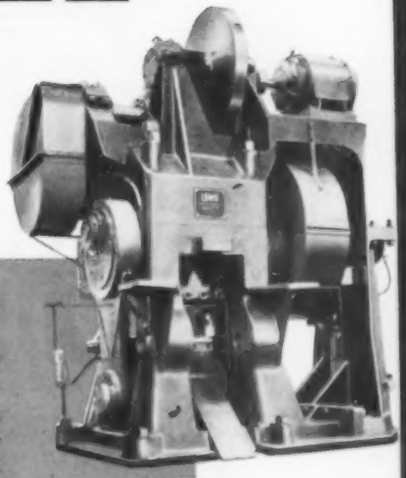


10" and 24" x 20" Four-High Reversing Mill Stands.

LEWIS ROLLING MILL EQUIPMENT

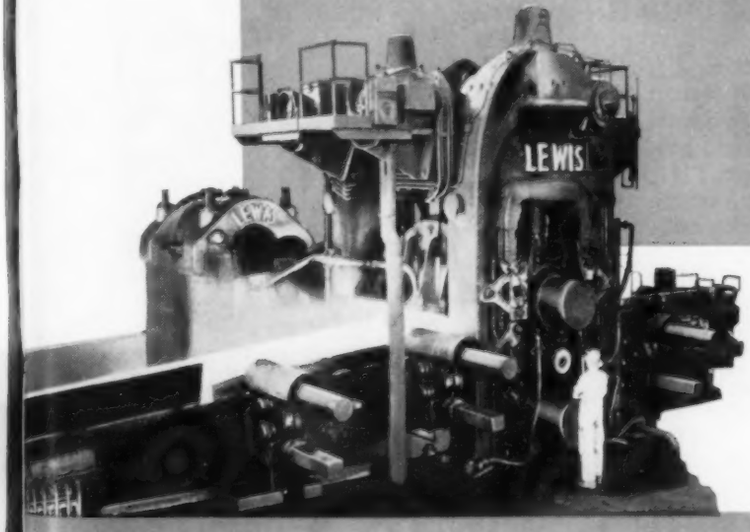


Lewis 8½" x 10" Two-High Laboratory Mill.



Exit side of Lewis 8" x 8" Up-Cut Shear.

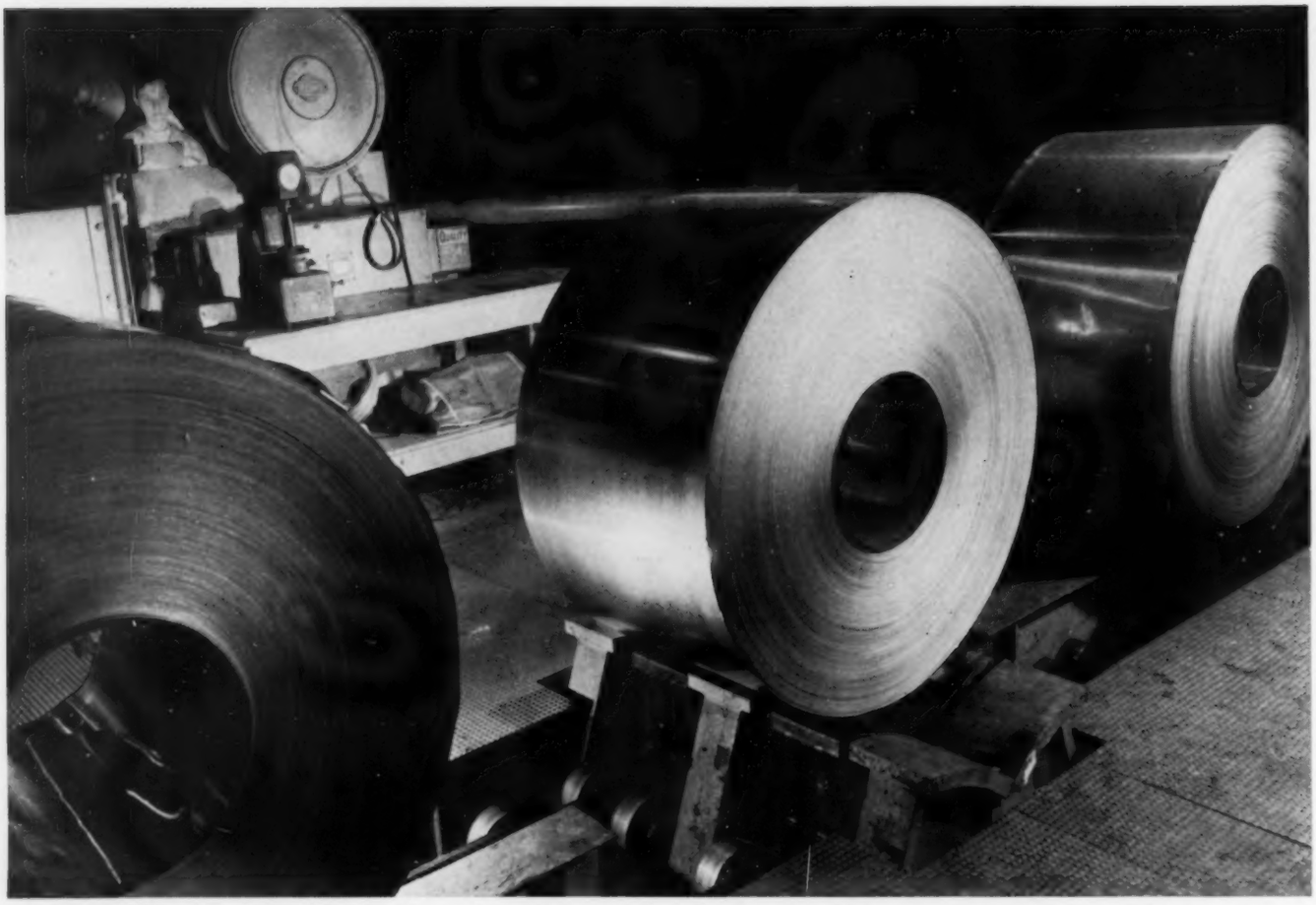
Lewis equipment will meet *all* your requirements whether you are modernizing your plant or increasing your rolling mill facilities. You can call on Lewis for a small laboratory mill, shear or a large plate mill—or anything in between. Lewis' ability to design and build efficient, cost-reducing machinery for rolling steel and non-ferrous metals is known throughout the industry.



26½" and 42" x 112" Three-High Balanced Finishing Plate Mill.

BLAW-KNOX

BLAW-KNOX COMPANY
LEWIS MACHINERY DIVISION
PITTSBURGH 22
PENNSYLVANIA



Precise weights of up to 40,000-lb. coils are recorded as they move along Link-Belt saddle top conveyor at temper mill delivery end.

Why Jones & Laughlin again selected LINK-BELT coil conveyors

Yield goes up . . . waste goes down handling 40,000 lb coils

HERE'S one mill that knows from experience how effectively Link-Belt conveyors cut coil handling costs. So pleased has Jones & Laughlin been with Link-Belt performance on their pickle line and five-stand tandem mill installed in 1948 that they again chose Link-Belt coil conveyors for their newest temper mills, cleaning and shearing lines.

In mills all over the country, Link-Belt conveying systems eliminate hours of lost time. Coils travel close together. They're handled gently, preventing edge damage. Down-time is reduced. Auxiliary devices transfer coils from one conveyor to another—turn, lower, tilt and weigh them with ease and precision. This increased mechanization means greater safety, reduced physical work for crews.

It pays to call in Link-Belt while expansion is still in the planning stage. The Link-Belt engineer—working with your own engineers, consultants and builders of mill and process equipment—can help you select the right conveying system for your exact needs.

13,282

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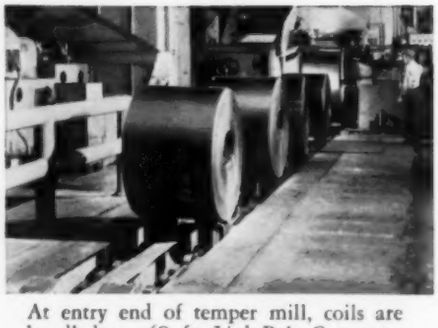
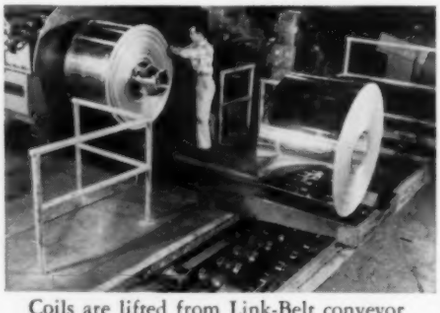
MATERIALS HANDLING, PROCESSING and POWER TRANSMISSION MACHINERY

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Scarboro, Ont. (Canada), Toronto (Canada), Elmira, Ont. (Canada), Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.



At entry end of temper mill, coils are handled on 49 ft. Link-Belt Conveyor.



Coils are lifted from Link-Belt conveyor to pay-off reel by hydraulic buggy.

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the only 100% American Metallic Recuperator

100% Protection on Service!

Hazen Recuperator Features:

- This application takes advantage of the natural upward flow of flue gases.
- Less stack draft is required.
- Greater percentage of flue gases reach recuperator.
- Increased preheat . . . due to availability of a larger percentage of flue gases at higher temperatures.
- Economies in initial cost . . . by reducing the required amount of excavating and furnace foundation.
- Further economy . . . by reducing the length of flue ordinarily required from furnace to stack.
- Greater accessibility for ease of cleaning.
- Walkways may be provided around the recuperator for convenience of inspection and cleaning.
- Recuperator, flue and stack may be supported from steel work independent of the furnace bindings.
- Recuperator may be applied above an existing furnace with a minimum loss in outage time.

Made of American steel and alloys . . . by American labor . . . for meeting American high performance standards

Consult us about improving the production and economy of your furnace operations

HAZEN ENGINEERING CO.

PARK BLDG., PITTSBURGH 22, PA.

TELEPHONE COurt 1-7030

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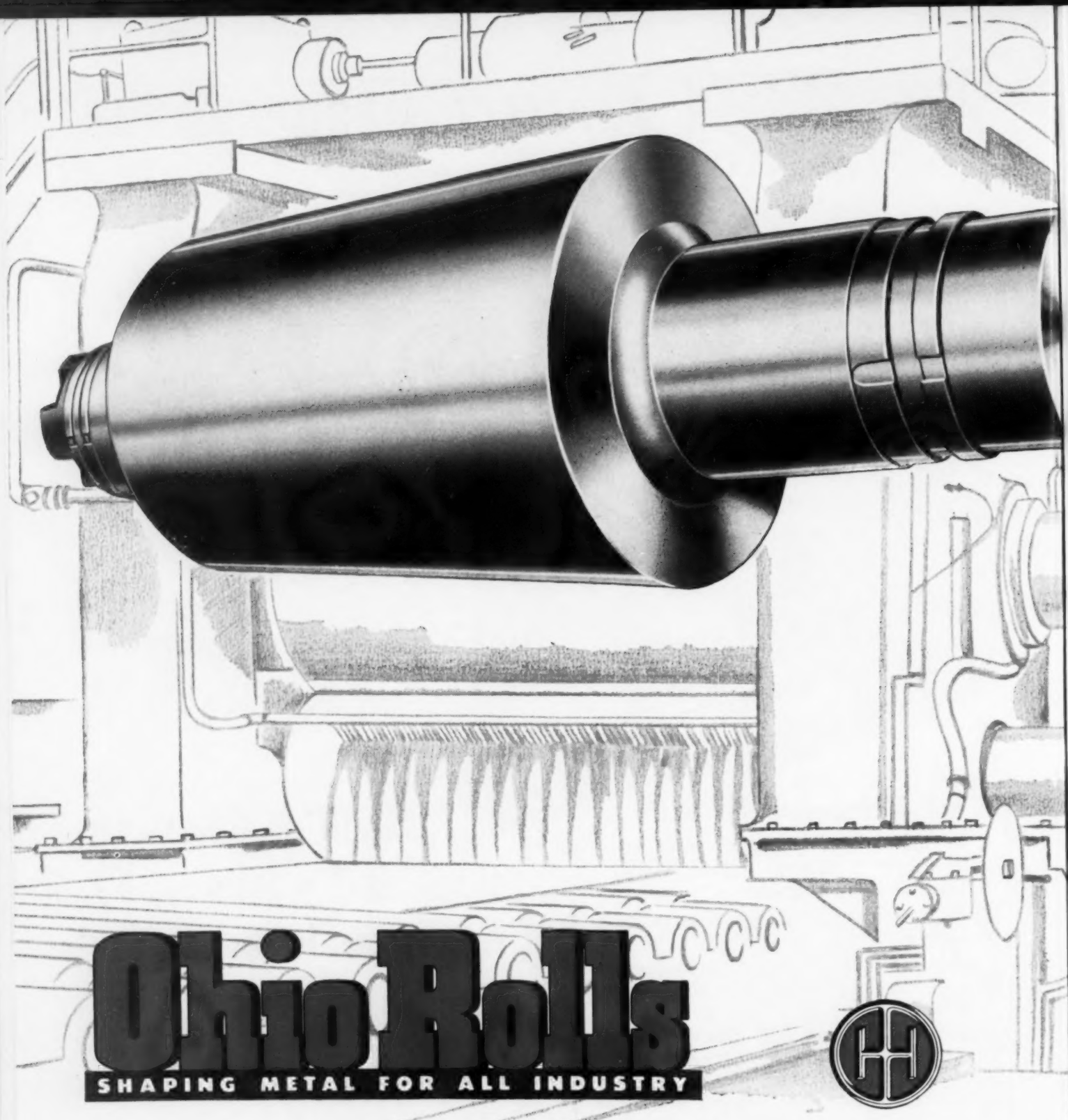

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THE OHIO STEEL FOUNDRY CO.

LIMA, OHIO • Plants at Lima and Springfield, Ohio

Industry News...

KAISER STEEL PLANS EXPANSION OF ROLLING MILLS TO INCREASE STEEL PRODCTION AT FONTANA

▲ Kaiser Steel Corp. has announced an $8,000,000 expansion program for its Fontana, Calif., rolling mills that will increase production of steel plate, sheet and tin plate by 120,000 tons a year for the West's growing industries and markets.

The expansion will increase by approximately 17 per cent the Fontana plant's output of flat rolled steel products, which are in particularly strong demand on the Pacific Coast and for which expanding markets are anticipated.

The expansion is made possible by production of steel ingots from Kaiser Steel's nine open hearth furnaces having substantially exceeded rated capacity, thereby making more metal available for rolling.

New facilities to be built include: More than a 50 per cent expansion of the continuous electrolytic tinning line to increase capacity from 130,000 tons to 200,000 tons of electrolytic tin plate per year. This reflects the growth of demand along the Pacific Coast for electrolytic tin plate by the large and constantly growing can-manufacturing and food processing industries. No expansion is planned in the company's hot dip tin plate operation.

Additions to increase the capacity of the plate mill and hot strip mill, operating continuously in tandem, by approximately 10,000 tons per month. (More than half of this production will be transferred to the tin plate mill for processing.) This will be accomplished by: Installation of a new handling and conditioning yard for slabs, and a third slab heating furnace in the plate mill.

Modification of the blooming mill to produce steel slabs 48 in. in width —one-third wider than the 36-in. slabs that can be rolled at present by the blooming mill.

Installation of a mechanized conveyor from the hot strip mill to the tin plate mill to eliminate the present freight car handling of the hot strip coils that are sent to the tin mill for processing into tin plate.

New facilities for increasing annealing capacity in the tin plate mill will be added to handle the increased electrolytic tin plate output.

ACQUIRES CANADIAN LIMESTONE DEPOSIT

▲ The acquisition of one of the finest deposits of open hearth quality limestone ever found in the North American continent was announced by Union Drawn Steel Co., Ltd., Hamilton, Ontario, a Canadian subsidiary of Republic Steel Corp.

C. M. White, president of Republic and also president of Union Drawn Steel Co., Ltd., said the latter company has acquired more than 1100 acres of land at Embro, (near London) Ontario, containing a deposit of high quality stone sufficient to supply Republic's open hearth furnaces for several generations at the present operating rate.

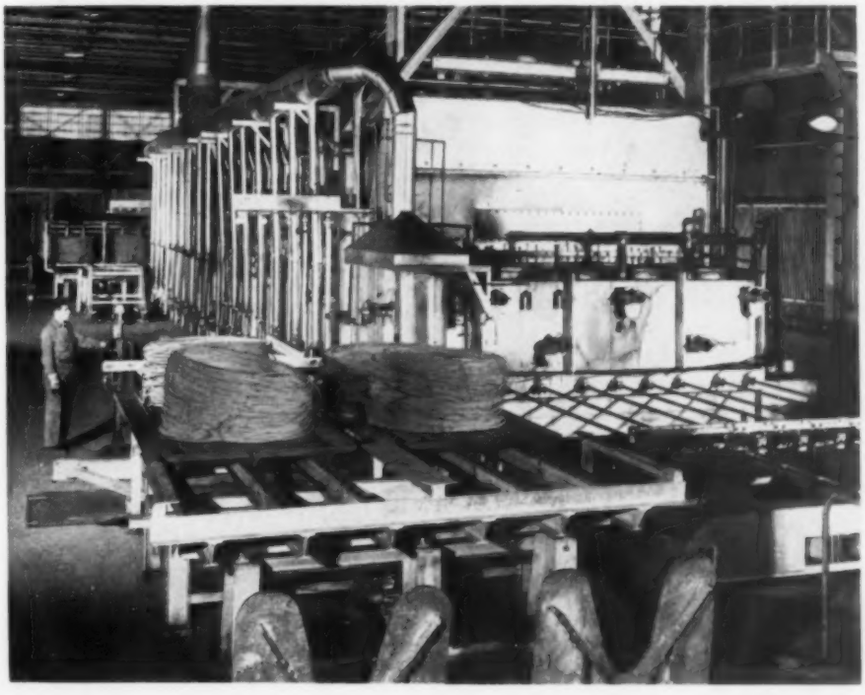
This limestone is chemically almost pure calcite and has a dense, microcrystalline structure which makes for ideal melting characteristics in the steel furnaces. It is known to petrologists as Vaughanite.

The deposit is located especially favorably for transportation to steel plants, particularly those in the Mahoning Valley, Canton and Massillon. Situated astride the St. Mary's branch of the Canadian Pacific Railroad and only 35 miles north of Port Burwell, Ontario, which is on Lake Erie, the stone can be brought across the lake into Ashtabula by a car ferry regularly transporting American coal to Canada. At the present time, the coal cars are usually returned empty.

Although limestone underlies a great part of the eastern United

ANNEALING FURNACE RESTORES CARBON TO COILS

Now in operation at Republic Steel Corp.'s Massillon, Ohio plant, Union Drawn Steel division, is this continuous carbon correction annealing furnace for carbon and alloy steel coils. The furnace anneals coils and restores to their surface the carbon burnt out in previous hot working operations. The furnace has an annual capacity of 12,000 tons of coils. It is the first furnace of its type and is a further development of carbon correction processes in annealing which have been developed by Union Drawn metallurgists in recent years. With necessary auxiliary equipment and building remodeling, the furnace took a year to design and install.



States, stone of the necessary physical and chemical characteristics for steel plant operations has become increasingly scarce in recent years. This situation has been of great concern to many companies in the industry.

Discovery of the limestone deposit resulted from the application of theoretical geology, combined with patient study and a good share of luck.

Several years ago, Republic's exploration geologists were assigned the task of searching for new reserves of this essential steelmaking material. In all, they personally observed, studied drilling records, or got analytical data on 6,000 limestone occurrences in the northeastern and north-central United States and southern Canada.

One by one these were eliminated because of chemical analysis, physical structure, location, transportation, small potential reserves, or quarrying problems.

An intriguing possibility emerged, however, of finding a large tonnage of easily quarried high quality stone in Oxford County, Ontario. For many years Vaughanite has been recovered on a modest scale in the valley of the Thames River, near Beachville, east of London. On either side of this narrow valley the bedrock is covered by a hundred or more feet of glacial sands and gravels. Conjecturing that the stone might extend in a wide arc beneath the thick barren cover, Republic geologists sought a zone where this stone would be near the surface. They studied the glacial and post-glacial history of the region, and called on farmers to ascertain if their wells had struck solid rock. Ultimately they selected a site near Embro for testing. Options were taken on twenty farms, and test drilling started. The very first drill hole struck excellent limestone 25 ft under the surface. At this point, the deposit was found to be 88 ft thick. Overburden consisted of earth and gravel. Subsequent holes found the stone everywhere less than 35 ft below the surface and in a bed ranging from 50 to 90 ft thick.

With the discovery of this outstanding deposit, Republic advances another step in its program of improvement in major raw material sources. Short on raw materials when the company was formed in 1930, Republic is now in a very favorable position in the industry in iron ore, limestone and high grade bituminous coal reserves.

A FEW CENTS PER MOLD
MEDICAL & SAFETY DEPT. APPROVED
NO MIXING • ODORLESS VAPORS
LONGER MOLD LIFE
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with DARMOLD
Ingot Mold Coating
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Tests conducted by leading steel producers show that DARMOLD increased the life of three different size molds by as much as 30%. The thin, film-like coating of Darmold keeps impurities from the ingot surface and it prevents the bond between ingot and mold that often results in costly "stickers." The high volatile content repels "splashes." The coating may be hand or crane sprayed or layed on with equipment you now own. Even "fill and drain" methods can be used. With Darmold you can look forward to savings in steady ingot production. Compare its low-cost per ingot ton with the savings you can obtain.

ALLEGHENY LUDLUM, BRACKENRIDGE, IS A CUSTOMER OF DARMOLD AND FERRO-PLAST

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REPUBLIC CONSTRUCTS IRON POWDER PLANT

▲ Construction of Republic Steel Corp.'s $2,200,000 plant on Landis Avenue in East Toledo, Ohio, was formally begun on November 25. The plant, scheduled for completion next summer, will be one of the country's largest for the production of iron powder. It marks the entry of the first of the nation's major steel companies into the comparatively new and much-discussed field of iron powder.

The iron powder industry is believed to have great possibilities for the future. A gear, for instance, made from iron powder rather than steel would enable the producer to eliminate all the iron and steel making and rolling operations and many of the machining operations necessary today in producing metal products. However, iron powder processes are

not at present competitively economically with conventional steel industry processes.

The Toledo plant will have a capacity of 50,000 lb of iron powder a day, a substantial part of the nation's present market, and has been designed for expansion to keep pace with the expected growth of the market. Ample space exists on the 16-acre site for such expansion.

The plant, located about a mile east of the Toledo city limits south of Woodville Road, will consist of one single story, L-shaped building, containing 17,000 sq ft of floor space. A Bay Terminal Railway siding will be constructed.

Iron powder is produced by largely a chemical-type operation. Following the practice established by the chemical industry, the major part of the reactive equipment will be installed outdoors.

Details of the patented methods Republic will use to produce iron powder have not been announced. However, it has been revealed that the process is entirely new, involving the use of hydrogen in the direct reduction of iron ore to iron powder.

Because the process is largely automatic, employment is not expected to exceed 100 people.

Primary user of iron powder at present is the automotive industry. However, more than 100 companies use iron powder to form precision mechanical and structural parts. The parts are formed by pressing the iron powder between dies under high pressure. They are then heated, causing the iron particles to weld themselves together to form a strong, unified mass with a smooth surface like a die-casting ready for use without machining. This permits intricate parts to be mass produced quickly and economically.

Iron powder also is used in flame scarfing and cutting of steel where it is added to intensify the heat of the flame. In its own steel plants, Republic makes extensive use of iron powder for this purpose.

In the rapidly growing field of powder metallurgy, iron powder has shown remarkable growth. Iron powder consumption in this country this year is estimated to be 12,000 tons, more than double the 1948 figure of 4900 tons.

Iron ore for the new Toledo plant will come from Republic's Adiron-

Install *more power* in the SAME SPACE!

install
C&D Slyver-Clad Batteries

Electric trucks have more power, work stronger and work longer when equipped with C & D *Slyver-Clad** industrial batteries.

C & D's Five-Fold method of insulation and retention holds active material in place on the positive grid and practically eliminates sedimentation. This reduces the size of the sediment space required and allows the use of longer and heavier plates. Thus in a C & D *Slyver-Clad* you get 20% more capacity—in *the same size tray!* And because this type of construction virtually eliminates "shedding," a C & D *Slyver-Clad* Battery lasts longer and delivers maximum capacity up to the end of its life. The next time you replace an industrial truck battery—*install more power in the same space*—install C & D!

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Manufacturers of Industrial Batteries since 1906

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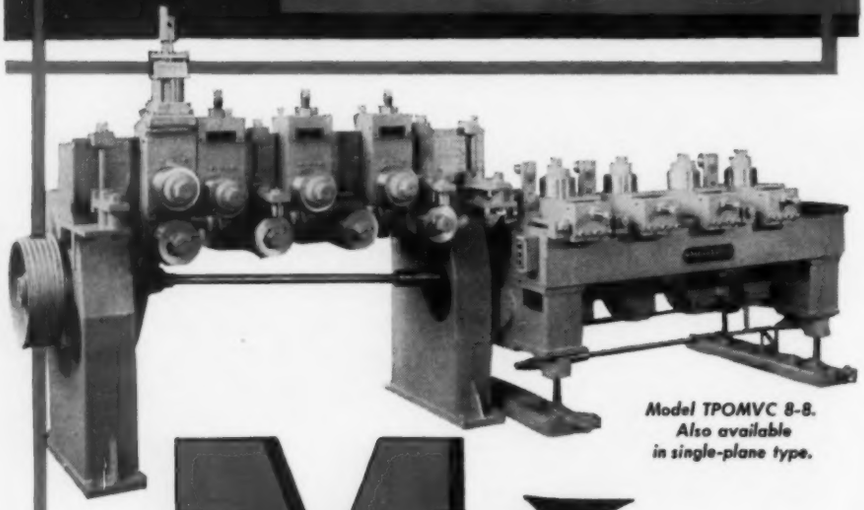
IN PRINCIPAL CITIES FROM COAST TO COAST

Variable Roll Centers... Adjustable Bending Spans

– More Versatile, Faster Straightening Of An Extreme Range of Shapes



Model TPOMVC 8-8. Also available in single-plane type.

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- Combines the advantages of fast and easy setup possible only in an overhung roll type straightener, with the exceptional flexibility achieved through independently movable rolls.
- Variable center rolls make it possible to set up the machine for any bending span up to the length of the bed, and to precision straighten an extreme range of shapes and sizes. This feature helps to prevent overloading of bearings, and assures unusual accuracy.
- Rolls can be moved directly opposite each other for cross-rolling or reforming of distorted cross sections of extruded stock or other workpieces simultaneously with straightening action. Top and bottom rolls, set in opposing pairs, also act as additional pinch rolls for extra traction required for handling hard-to-straighten shapes.
- Rolls are quickly, easily changed by removing locknut on end of each shaft.
- An electric motor drive raises or lowers the movable section of the machine to line up with the other section.

Write For Complete Details

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MO.

dack mining operations in upper New York state and from Liberia, West Africa, where the Liberia Mining Co., in which Republic has a majority stock interest, is mining one of the world's richest iron ore deposits.

COMPANY ESTABLISHES PITTSBURGH HEADQUARTERS

▲The Curry Air Shear Corp. has been established with headquarters in the Oliver Building in Pittsburgh, Pa. The new company will manufacture a line of air-operated shears for use in the steel and general manufacturing industries.

Albert Curry, Jr., is president of the firm. Thomas B. Hudson, Jr. is vice president. Mr. Curry also is president of Albert Curry Co., Inc., and a director of Kopp Glass, Inc.

J & L TAPS 1000TH HEAT FROM PILOT FURNACE

▲ The 1000th heat of steel was tapped from Jones & Laughlin Steel Corp.'s experimental open hearth furnace in the Metallurgical Research Laboratory in the Hazelwood section of Pittsburgh, Pa., recently.

Installed in 1938, this small furnace is used to bridge the gap between research and regular mill practice. Originally it had a capacity of 1500 pounds, but to closer approximate actual mill operations and to avoid special handling, the furnace was increased in 1939 to handle up to 8900 lb of metal from which a four-ton ingot can be made.

This small furnace is used exclusively for steelmaking research and development and is capable of producing steel of any analysis that can be made in J&L's mills and can be used in the study of any desired deoxidization practice, including rimmed, killed, semi-killed, and capped steel.

The experimental furnace is of the stationary type, fired with natural gas, and is entirely hand charged. Mill size slab and billet ingots are teemed from the furnace and processed in J&L's Pittsburgh works' blooming, strip, and bar mills. Samples from these rolling mills are returned to the laboratory for testing and the products often shipped to customers for evaluation.

The laboratory open hearth furnace is used only after a great deal of preliminary work has been accom-

plished; when the particular project underway has been developed to the point that plant size ingots are necessary for a complete and exhausting experiment. Generally, once the laboratory phase of a project has been completed, only a minimum change is required to translate laboratory furnace practices to the corporation's mills.

The experimental open hearth furnace is a part of the laboratory's steelmaking shop in which are also a high-frequency induction furnace capable of producing 35-lb heats of steel and an electric arc furnace with a capacity of 500 lb of steel per heat. The laboratory also has auxiliary equipment such as an overhead crane, ladles, molds, three rolling mills, wire heat-treating equipment, a salt spray cabinet for corrosion testing, welding machinery, and a 500-lb steam forging hammer.

AWARD "PACKAGE" CONTRACT TO DRAVO

▲ McLouth Steel Corp., Trenton, Mich., has awarded Dravo Corp. a multi-million-dollar "package" contract to furnish and erect complete facilities for new boilers and turboblowers, two 12-gross ton ore bridges and a new river dock.

The contract also includes design, fabrication and erection of all plant piping; furnishing and installing of switchgear for handling primary voltages to the ore bridges, blast furnace and river pump station; and furnishing and erecting of pumps for main mill water supply and a 4,000 kw generator unit.

The new facilities will be built at the Trenton works of the steel company in connection with its $100-million expansion program.

The ore bridges will be used to unload ore and limestone from lake carriers and to stock and reclaim these raw materials for the blast furnace. Each bridge, to be built by Dravo's Engineering Works Division, will have an overall length of approximately 545 ft. They will operate on tracks along the wharf on the Trenton channel of the Detroit River.

The dock, to extend some 777 ft along the river, will be constructed of 25 diaphragm type cells of steel sheet piling. Concrete beams supported by wood piling driver within the cells will carry tracks for the river end of the ore bridges. The dock is being

MOHR ENGINEERING

...A Timely Service to Meet Steel Mill Requirements

To meet today's demand for engineering talent, Mohr have increased and strengthened their engineering staff with men who have had long experience in steel plant design and operations. They are ready to help you.

Mohr specialties are designed for steel plants, blast furnaces, open hearths, sintering plants, power houses and other steel mill equipment. Within the past two years, Mohr Engineers have designed four complete blast furnace plants including power house and other auxiliary facilities.

Mohr service is flexible and as complete as your needs require. It can relieve you of part or all of the detail on any project you are considering.

In the modernization of existing facilities and in the design of new construction, Mohr's experienced engineers offer novel and economical solutions to foundation, mechanical, electrical, piping or power house problems. In addition, the uses of Mohr's many patented features are available to Mohr customers.

Your inquiry is invited.

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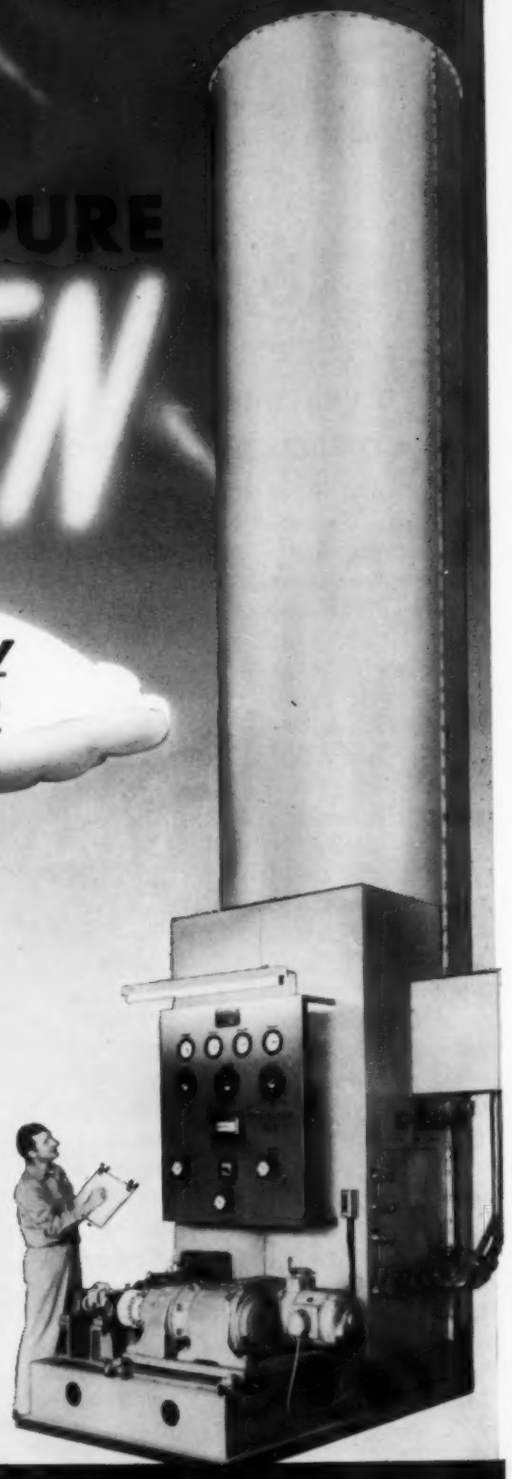

Low cost inert gas—high-purity nitrogen in large quantities—and low cost high-purity oxygen—can now be made in the same generator. If you use oxygen—and use inert gases for annealing, steel making, heat treating or furnace brazing . . . write us your requirements . . . ask on company letterhead for our NEW 36-page BROCHURE. *Air Products, Incorporated, Dept. P, Box 538, Allentown, Pa.*

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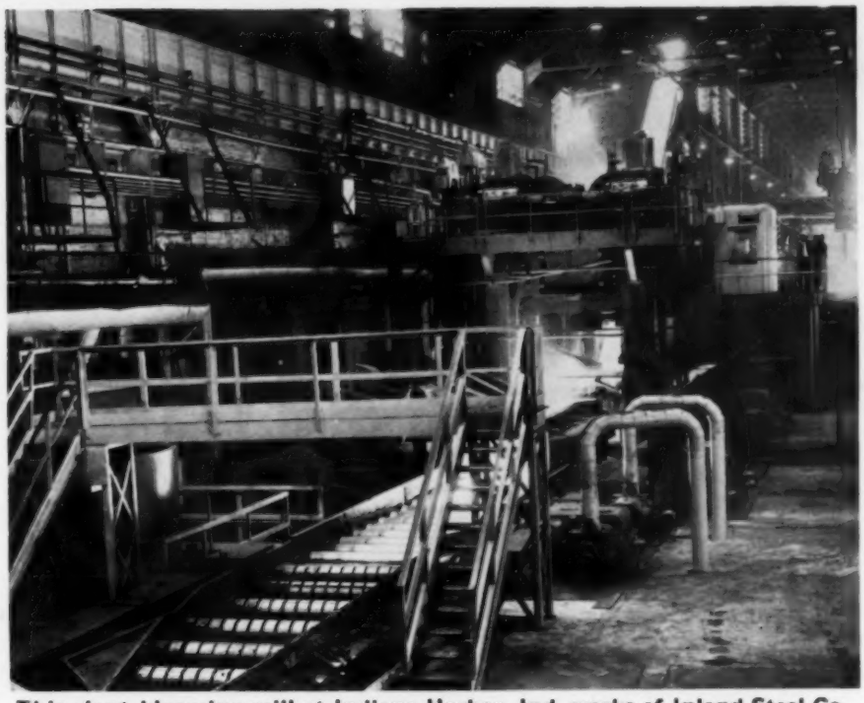


This giant blooming mill at Indiana Harbor, Ind. works of Inland Steel Co., was modernized from 40-in. to 46-in. rating in 23 days. Enlargement of auxiliary equipment will increase mill's capacity 25 per cent over old installation.

constructed by Dravo's Contracting Division.

REBUILD BLOOMING MILL AT INDIANA HARBOR

▲ Inland Steel Co. has announced that one of the three blooming mills at its Indiana Harbor, Ind., works has been completely renovated during a fast 23-day changeover in which production fell only slightly below full operating capacity.

The blooming mill, which formerly was rated at 40 in., now has a 46-in. rating and will be able to roll larger ingots and increased tonnages with greater versatility.

Production loss was held to a minimum and amounted to an estimated 100,000 tons, company officials said. Some steel slabs were purchased from other steel mills to supply Inland's finishing mills during the changeover. While the blooming mill was being modernized, the company took advantage of the occasion to make repairs on several open hearths which normally feed ingots to the mill.

Further renovation of the blooming mill facilities during the next two years will see the installation of new shears, tables, and transfer and auxiliary equipment. When the alterations are completed, the mill's capacity will have been increased 25 per cent or more.

The old 40-in. blooming mill was installed in 1916. Wilfred Sykes, then an electrical engineer with Westinghouse, engineered and supervised the installation of the original electrical equipment, some of which is still used in the new mill. In the intervening years Sykes became president of Inland and now serves as chairman of the executive committee.

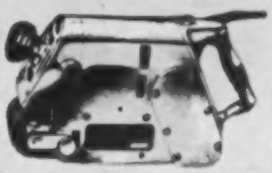
In the recent face-lifting, the mill was equipped with new mill housings, pinion housing, front and back tables, and manipulating and auxiliary equipment. The construction was handled by Continental Foundry and Machine Co.

More than 229,000 board feet of lumber was used in the construction. 21,000 ft of conduit, 118,000 ft of wire, and 9,000 ft of piping were used, and more than 3,000 cu yd of new concrete were poured during the changeover.

PURCHASE AMERICAN ORE RECLAMATION CO.

▲ Design and construction services of Koppers Co., Inc., Pittsburgh, Pa., to the nation's steel industry were further expanded by the purchase of the business of American Ore Reclamation Co.

For many years a leader in the design and engineering of sintering machines and sintering plants, American Ore Reclamation Co., of Chicago, Ill., has been credited with many out-



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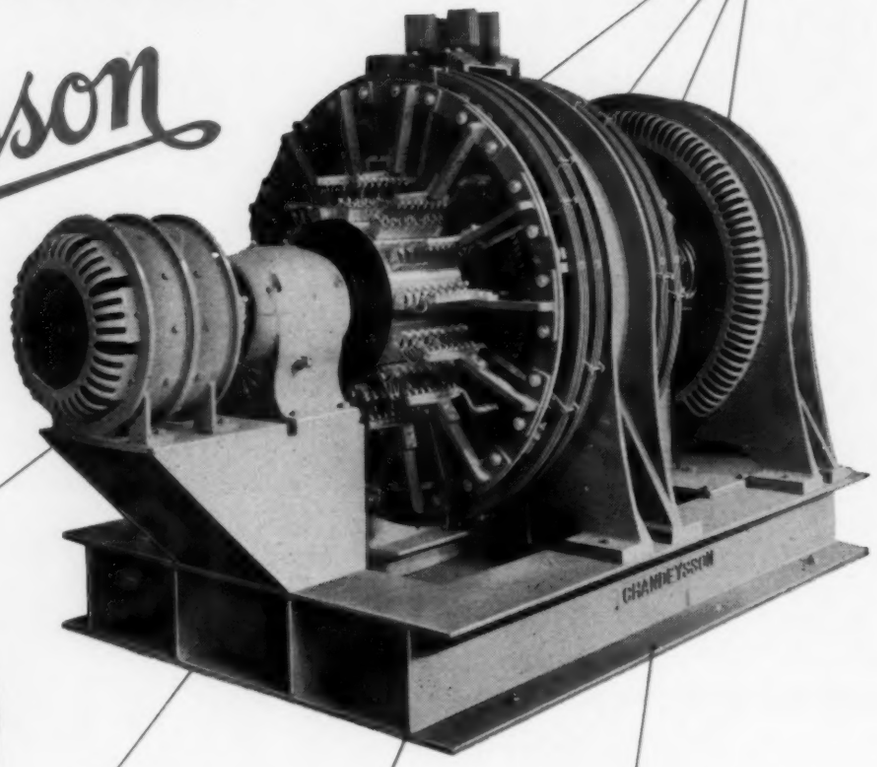
For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

DISCOVER THESE 4 Hidden Savings

in Power Conversion for Plating with the New

Chandeysson Motor-Generator



1

USE LESS POWER...
with the overall efficiency of 85% *plus* of the Chandeysson Motor-Generator . . . savings that can mean hundreds of dollars per year as compared with other power conversion methods.

2

GET MORE OUT OF THE POWER YOU PAY FOR...
with the Chandysson synchronous motor's built-in 80% leading power factor. Shop current can be reduced as much as 11% for the same load all along the line . . . cutting your power bills . . . reducing transformer and feeder losses throughout your entire plant.

3

A LIFE-TIME INVESTMENT...
designed to pay for itself over and over again in peak efficiency service for many years to come. Original Chandeysson units are still in constant use after almost half a century of service . . . and they always have a high resale value.

4

EXTRA OVERLOAD CAPACITY...
when you need it most. Your Chandeysson Motor-Generator can carry loads far in excess of rated capacity for long periods of time, without damage to the unit. You can always depend on it in emergencies.

535

Get complete facts and figures on the overall savings made possible by the new Chandeysson Motor-Generator.
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standing contributions to the technology of iron ore agglomeration. It has designed a major portion of all ore sintering equipment in the United States.

Sintering is a process for converting fine-sized ore into larger lumps by passing air through a mixture of the fine ore and fuel so that the fuel is burned and the ore particles are consolidated.

Although specializing for many years in iron ore sintering, American Ore Reclamation also has been active in the non-ferrous fields, having supplied the largest sintering machine in operation for an Oklahoma zinc producer.

Stockholders of American Ore Reclamation have approved the sale of the business on the basis of Koppers competitive bid with the final transaction being consummated in Chicago, according to General Somervell.

Interest of the steel industry in the utilization of low-grade taconite ores through ore separation and agglomeration and in the economic preparation of iron ore fines and blast furnace flue dust for smelting has increased in recent years with the gradual depletion of domestic high-grade ore reserves. With these developments has arisen a growing need for engineering services embracing all aspects of the sintering process.

PLAN IMPROVEMENTS AT VANDERGRIFT PLANT

▲ United States Steel Corp. has announced an extensive program to augment the finishing facilities at its Vandergrift, Pa., plant to include production of grain oriented silicon sheets and coils, essential to national defense, and make it a completely modern finishing mill for the production of all types of silicon sheets.

When installation of new equipment has been completed the proportion of cold rolled sheets as compared to the hot rolled product will be increased to follow the trend in product demand. It will also make it possible to increase production of silicon steel with improved electrical properties used in the most modern types of power transformers and electrical equipment.

The equipment to be installed includes new continuous annealing

(*Please turn to page 174*)

COMPARE these Scarfing Rings used in the tip of a Gas Torch . . .

KENTANIUM Ring after 1,960 HOURS

SUPER-ALLOY Ring after 162 HOURS

There's no sign of wear on the Kentanium ring and it's still on the job . . . after 1,960 hours (80 days) of service! Compare this performance with that of the super-alloy ring that had broken down from thermal shock, abrasion, and oxidation after only 162 hours . . . a better than TEN to ONE record in favor of Kentanium. This is a typical example of how industry is effectively using heat-resistant Kentanium.

What's Your HOT Design Problem?

If you need a material having long service life at elevated temperatures, investigate Kentanium . . . an exclusive development by Kennametal. It is a titanium carbide base composition.

Kentanium resists thermal and physical shock, withstands abrasion and oxidation, and retains great strength at 1800°F and above. It weighs only ⅔ as much as steel; is up to 93 RA in hardness.

Many grades of Kentanium are available to meet combinations of specific conditions. A wide variety of simple or complex shapes can be produced, to meet your specifications. Ask our engineers to recommend how you can best apply this remarkable, new heat-resistant material.

An Exclusive Development of KENNAMETAL® Inc., Latrobe, Pa.

KENTANIUM

HEAT-RESISTANT, HIGH-STRENGTH, LIGHTWEIGHT CEMENTED TITANIUM CARBIDE

SALES OFFICES IN PRINCIPAL CITIES

3-45

Right: Two 5000 hp main drive motors (at rear) are direct-connected through spindles to the top and bottom rolls. Exciter sets (foreground) provide adjustable a-c power to excite field windings of main drive generators and motors.

World's fastest reversing blooming mill powered by Westinghouse

Jones & Laughlin's new 46-inch, high lift blooming mill at Pittsburgh owns the world's record for fast reversal. In just one second, the 10,000 hp twin motor drive reverses from 40 rpm in one direction to 40 rpm in the other direction. Two giant motors turn smoothly at full base speed, and one second later—with no visible strain, no perceptible vibration—they're whirring with equal calmness in the opposite direction.

"Without a hitch". "This mill went into operation without a hitch," says George Kaufman, J & L's Chief Electrical Engineer. "Westinghouse Steel Mill Specialists worked with our engineers and the mill builder from the first. As a result, operation of the mill more than met the requirements of our engineering and operating departments."

At first, too fast. For fast reversals of the main roll motors to be of value, the auxiliaries (main roll screwdowns, mill table motors and manipulators) must also act rapidly. Proof that they do was shown in early tests. The manipulators, on the first try, operated so quickly that a ten-ton ingot was flipped completely over—180 degrees instead of 90.

Rototrols® speed operation. Rototrol regulators provide high forcing voltages to the mill auxiliary-generators and the main drive exciters. Due to the co-ordinated design of the regulating system, auxiliary-generator voltages are reversed in less than one second. Forced by fast voltage charges, the drive responds instantly to the operator's flip of the master switch.

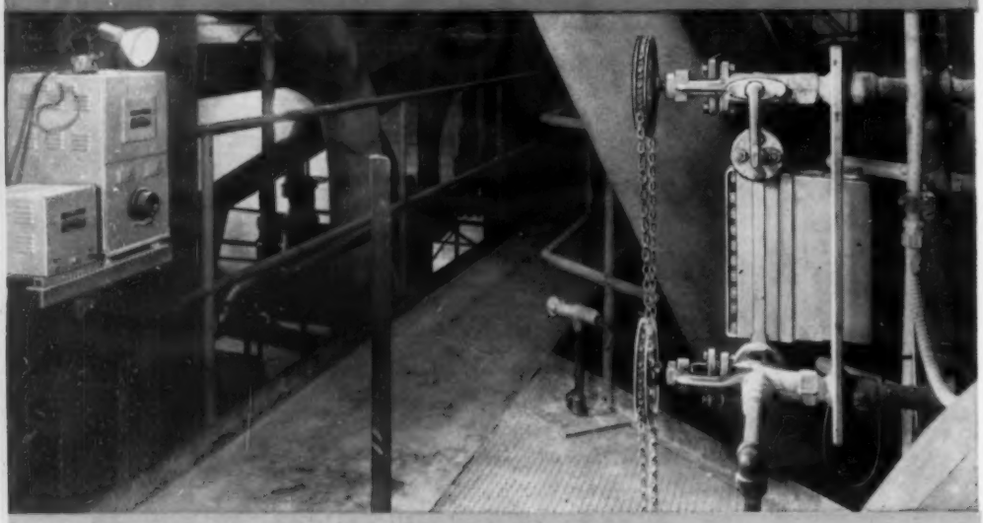
Next time, call Westinghouse. Imaginative, dollar-saving engineering like this can be applied to *all* steel mill problems. When your next job comes up, take advantage of Westinghouse experience in steel—the widest in the electrical industry. Call your nearby Westinghouse office early in the planning stage. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-94987

YOU CAN BE SURE...IF IT'S Westinghouse

NOW You Can *See* Where You Can't *Look*

5 YEARS OF CONTINUOUS OPERATION Prove Dependability of DIAMOND "UTILISCOPE"

(WIRED TELEVISION)



"UTILISCOPE" *camera at drum elevation SEES actual boiler water level.*

In 1948, Tidd Plant of Ohio Power Company (subsidiary of The American Gas & Electric Company) installed a Diamond "Utiliscope" so that the operator at the control panel could SEE the boiler water gauge several floors above. The camera location (adjacent to the big boiler drum) is hot and dusty. Auxiliary machinery causes vibration. The installation (including the original camera tube) has been in continuous use . . . 24 hours a day . . . 7 days a week for over 5 years, with very little maintenance. This is the first system of industrial television purchased in the U.S. and is still in continuous operation.

Probably there are places in your plant where you can use the DEPENDABLE "Utiliscope" (wired television) . . . the great new industrial aid. It is saving money and improving operations in steel mills, power plants, foundries, coal mines, and a wide variety of manufacturing plants. Write for Bulletin 1136E.

6574

"Utiliscope" Camera (above) and Receiver (below)

DIAMOND POWER SPECIALTY CORP.

FIRST IN INDUSTRIAL TELEVISION

LANCASTER, OHIO • OFFICES IN 39 PRINCIPAL CITIES

Diamond Specialty Limited—Windsor, Ontario

SINCE 1903, DIAMOND HAS MANUFACTURED QUALITY EQUIPMENT FOR INDUSTRY

(*Continued from page 171*)

lines, new high temperature box type electric annealing furnaces, and new box type gas fired annealing furnaces. In addition, there will be auxiliary equipment such as cranes, tractors, slitters, shears and power facilities. Work will begin immediately and the entire program should be completed in 1955.

This is the second step in modernizing the Vandergrift plant. Prior to 1947, electrical steel production was confined to hot rolled hand mill sheets. In 1947 a cold reduction mill and continuous annealing furnaces were installed to furnish electrical steel in coils.

At the same time it was announced that improvements will be made in open hearth and primary mill operations at Clairton, Pa., works to produce silicon steel slabs for the Vandergrift plant. When the improvements at Clairton are completed next fall the cold metal open hearth facilities and slabbing mill at Vandergrift will no longer be needed.

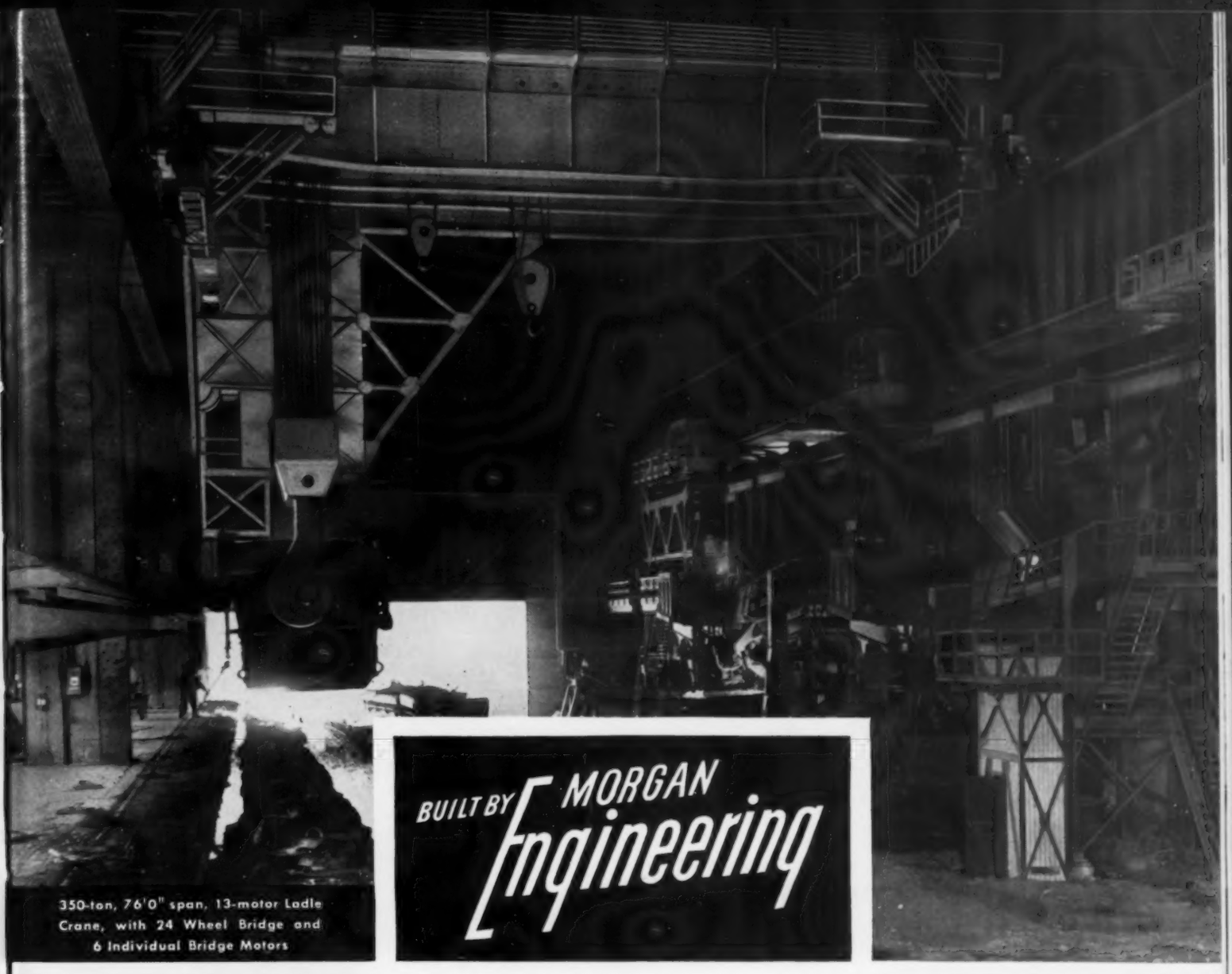
Since slabs are now hauled about 40 miles from Vandergrift to Irvin Works for rolling into coils and Clairton Works and Irvin Works are practically adjoining, the overall efficiency of silicon steel production will be increased by the change.

WESTINGHOUSE DONATES ENGINEERING LABORATORY

▲ An electrical engineering laboratory, the only one of its kind existing in an educational institution in the world, has been donated to Carnegie Institute of Technology, Pittsburgh, Pa., by Westinghouse Electric Corp.

Valued at approximately $100,000, the new installation is expected to stimulate student interest in power engineering which has been somewhat overshadowed by the swift rise of developments in the communications field.

The laboratory will be used for education and research dealing with the detailed and advanced study of electrical power systems and advanced study of alternating current generators. The facilities of the lab will provide for advanced instruction in rotating machinery for senior undergraduate students and work in power system stability for graduate students. This laboratory is the largest single facility ever donated by



350-ton, 76'0" span, 13-motor Ladle Crane, with 24 Wheel Bridge and 6 Individual Bridge Motors

BUILT BY MORGAN Engineering

MORGAN CRANES AT INDIANA HARBOR

Illustrated are three Morgan Open Hearth Cranes at The Youngstown Sheet and Tube Company's new Open Hearth. These cranes have all latest modern features, especially designed for Open Hearth service. *Your inquiries will be appreciated.*

25-ton, 8-motor, 107'0" span Soaking Pit Crane

12-ton, 27'0" span Floor Charger

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2 High Hot Strip Mill Table Rolls in plant of Dominion Foundries and Steel Ltd., Hamilton, Ontario, Canada. Arrows indicate location of J-M Clipper Oil Seals which protect bearings against dirt and other adverse conditions

Engineers at Dominion Foundries and Steel Hot Strip Mill report:

"Bearings better protected— damaging dirt sealed out with Clipper Seals"

TABLE ROLLS of the 2 high strip mill at Dominion Foundries and Steel Ltd. must operate efficiently despite severe service conditions. Life of the Roll Bearings is constantly threatened by dirt and salt from strip mill operations.

To provide better protection, engineers replaced the original bearing seals with J-M Clipper Oil Seals. Long after this installation was made, Clipper Oil Seals are still providing far better bearing protection than the material formerly used. They seal out mill scale, salt and other foreign matter which might work into the bearing housings. They remain efficient despite high oil and air temperatures. They protect bearings by assuring clean lubrication.

Clipper Oil Seals offer many advantages wherever accurate fit, longer life and greater sealing effectiveness are required. These precision-moulded oil seals provide easy installation because the tough, dense heel affords just the right amount of rigidity for a press fit in the cavity . . . while the flexible lip, held in light but positive contact with the shaft by an especially designed garter spring, provides effective sealing at all times.

Made in both split and endless types, Clipper Oil Seals are available in a wide variety of designs, to meet practically any sealing requirement. For complete details and literature write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER OIL SEALS

an industry to an educational institution.

Formerly a part of the research and development facilities of the East Pittsburgh, Pa., plant of Westinghouse Electric Corp., the new installation was used there in research contributing to the present expansion and interconnection of electrical systems in this country. Although Westinghouse may still use the equipment in the solution of possible future problems, all data gathered in the course of research at Tech will be made available to the electrical industry through the usual channels.

Because of the new equipment, Carnegie Tech will be able to set up a miniature power system closely duplicating actual transmission lines and interconnected generator stations. Specifically, the laboratory was designed to solve problems dealing with voltage regulators, transient characteristics, exciter characteristics within stability limits, and subtransient reactances. It is in the latter field that most research will probably be done.

The laboratory area is enclosed by a safety fence and an accompanying soundproofed briefing room. The equipment consists of two 100 kva alternating current generators, each driven by separate 150 hp, d-c motors, together with 72 reactors, each rated at one ohm-100 amperes-60 cycles. These units are accompanied by the necessary circuit breakers, high and low voltage switchgear, transformer banks, and metering facilities.

DIAMOND POWER OPENS NEW ELECTRONICS LAB

▲ The Electronics Division of the Diamond Power Specialty Corp. has just moved into its new electronics laboratory which is adjacent to the manufacturing plant at Lancaster, Ohio. This new building has approximately 30,000 sq ft of floor space and houses the most advanced facilities.

The laboratory is being used for the continuing development and construction of the Diamond "Utiliscope" (wired television) and for the development of other electronic instruments and controls. Problems relating to the application of this equipment in various basic industries are also carried through preliminary

(*Please turn to page 181*)

There's No Mystery to Top Heating Performance . . . . .

BLOOM
ENGINEERING

produces "magical" results through sound engineering practice

There is no real mystery in heat transfer—the basic facts are known. It is through careful use of these facts—supported by broad experience—that Bloom Engineering's qualified personnel can develop top furnace performance.

BLOOM ENGINEERING SERVICE includes:

Heat Process Analysis—This service covers such basic factors as:

1. Production requirements
2. Sizes of metal heated
3. Metallurgical requirements:
   a. Optimum time-temperature heating curve
   b. Soaking time

Heat Pattern Design—Correct temperature distribution, or *Heat Pattern* within the furnace chamber gives desired time-temperature curve and required soaking time.

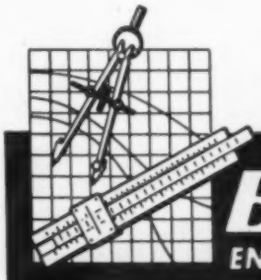
To give desired heat pattern, these factors are carefully balanced:

1. Number, size, location of burners
2. Flame length, temperature and characteristic
3. Furnace shape or contour

Heat Process Development—Where experience with a given material or process is lacking, the necessary constants and other required factors relating to the problem are developed in Bloom Engineering's modern laboratory, thus eliminating guesswork.

Operating Advice—When situations arise which cannot be anticipated by the furnace control equipment, prompt and correct action by the operator is of utmost importance. Bloom service includes the education of operators to meet such situations.

It is our aim, not only to furnish good equipment, but also to insure an efficient over-all operating process.



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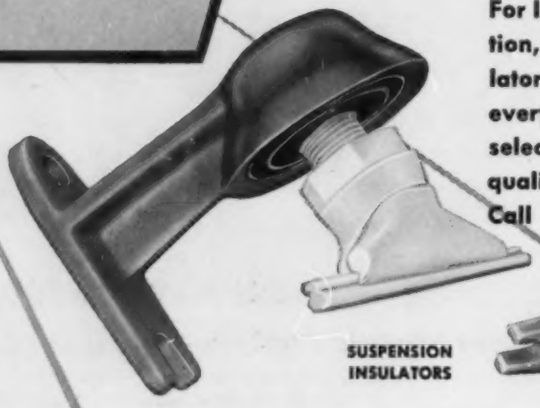
CONTACT RAIL (TYPE BMS)

"SERVICE-ENGINEERED"

FOR UNFAILING PROTECTION ON THE TOUGHEST JOBS!

For longer, stronger life and peak protection, there's a Keystone Industrial Insulator that's "service-engineered" to meet every need. Let ESM engineers help you select the right mechanical and electrical qualities to solve your insulator problems. Call on them soon.



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Fibreglass reinforcement and superior compounds provide maximum impact strength with excellent resistance to arc track, chemicals, heat and weather.

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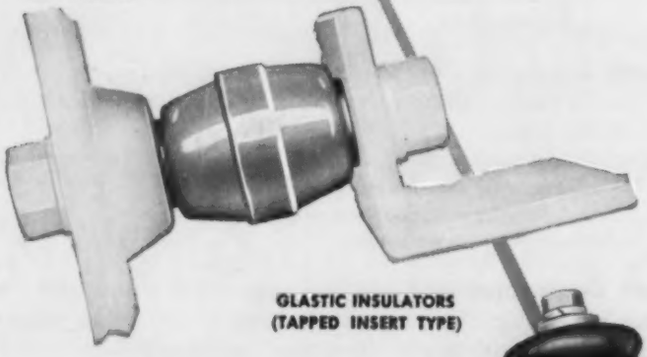
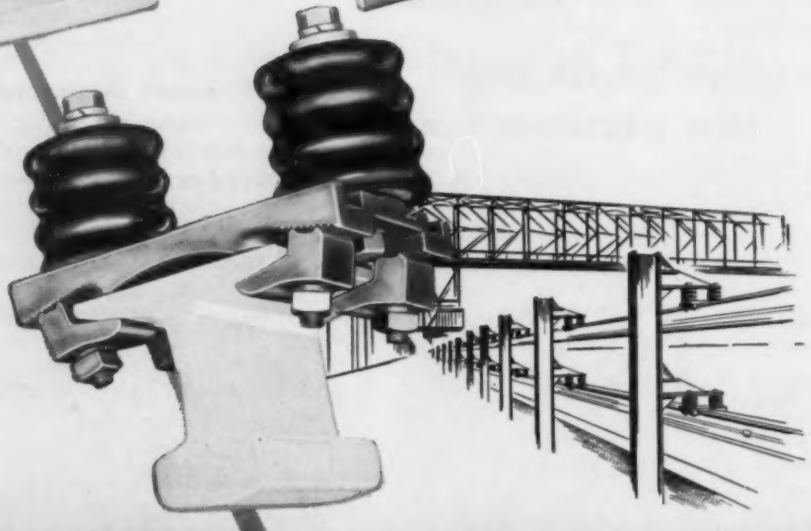


GLASTIC INSULATORS (TAPPED INSERT TYPE)



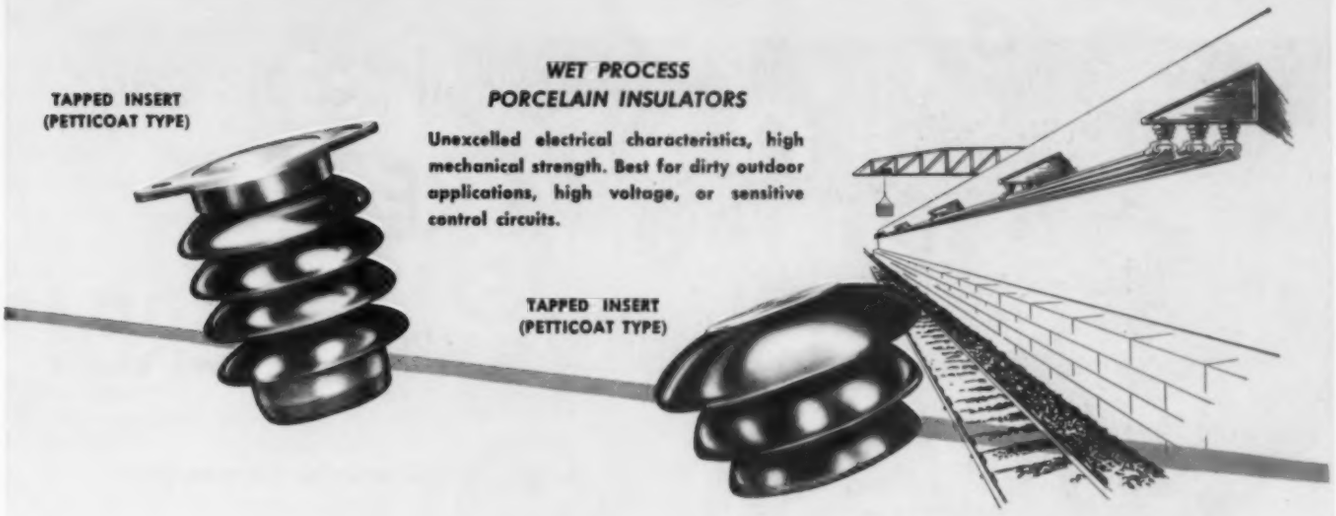
Basic units shown have great variety of application by use of proper fittings, selected from our Industrial Catalog. Write for illustrated folder.

ELECTRIC SERVICE MANUFACTURING CO.

TAPPED INSERT (PETTICOAT TYPE)

WET PROCESS PORCELAIN INSULATORS

Unexcelled electrical characteristics, high mechanical strength. Best for dirty outdoor applications, high voltage, or sensitive control circuits.

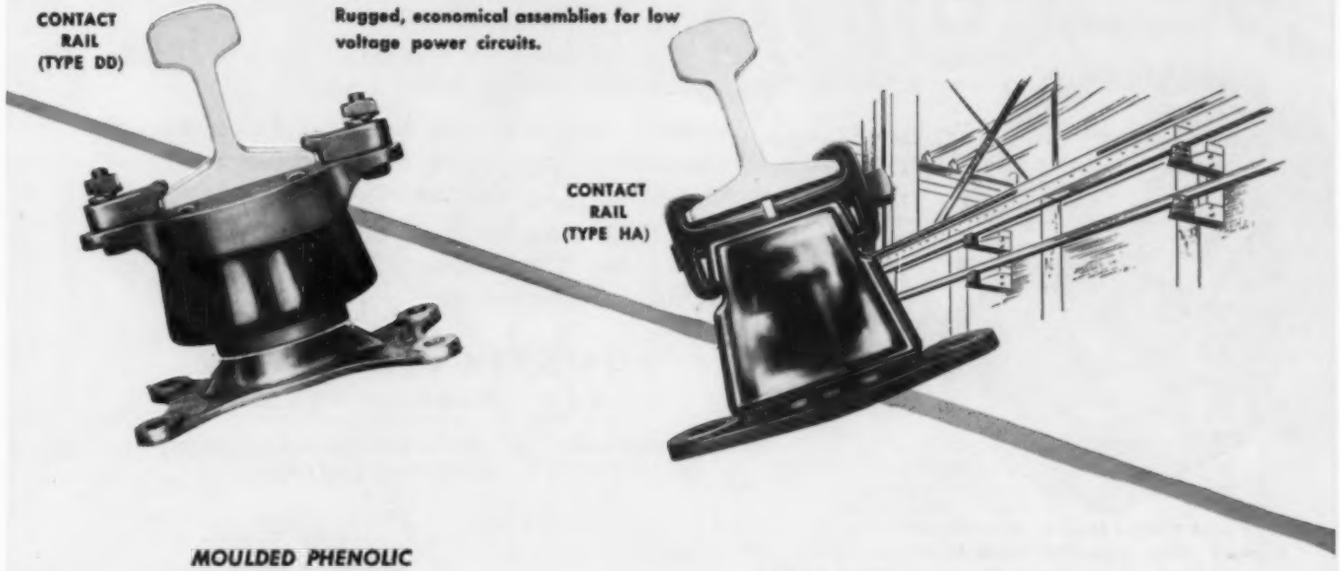


TAPPED INSERT (PETTICOAT TYPE)

DRY PROCESS PORCELAIN INSULATORS

Rugged, economical assemblies for low voltage power circuits.

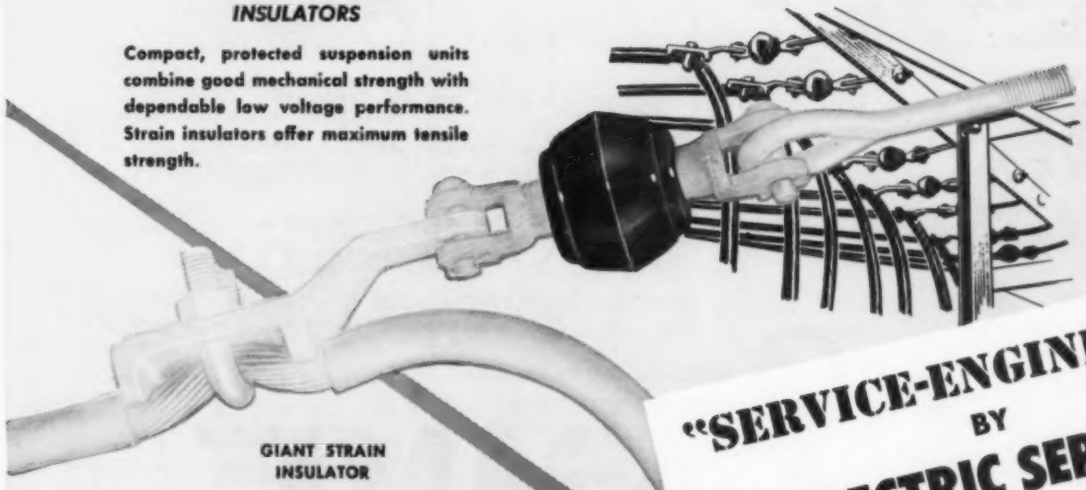
CONTACT RAIL (TYPE DD)



CONTACT RAIL (TYPE HA)

MOULDED PHENOLIC INSULATORS

Compact, protected suspension units combine good mechanical strength with dependable low voltage performance. Strain insulators offer maximum tensile strength.



GIANT STRAIN INSULATOR

"SERVICE-ENGINEERED" BY ELECTRIC SERVICE

Philadelphia 32, Pa.

Represented in Canada by Lyman Tube and Bearings, Ltd., Montreal and Toronto

Communist machine-gun fire dropped him in combat. But whole blood kept him alive, saw him through the hospital. He thanks you for his life.

She'd been exposed to polio. A new serum, *Gamma Globulin*, made from blood, helped ward off the dread disease. She thanks you for her life.

A tornado whipped suddenly across her home town. She was badly injured by falling debris. But a quick operation, several transfusions pulled her through. She thanks you for her life.

Three grateful people say: "we're HERE... because you were THERE!"

Each one of these people is alive today because someone gave blood.

If you've given blood before, you know how easy it is—how quick and painless. And you know what a wonderful feeling it is when you realize that what you've done may give another person his life.

Now you are asked to give blood . . . again and again. And you can do it safely every 3 months.

Because America's need for blood has increased enormously—for our armed forces, for accident and disaster victims at home, for new disease-fighting serums.

Many a life hangs in the balance! Will you help? Call your Red Cross, Armed Forces or Community Blood Donor Center today!

BUSINESS EXECUTIVES CHECK THESE QUESTIONS

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ◯ HAVE YOU GIVEN YOUR EMPLOYEES TIME OFF TO MAKE BLOOD DONATIONS?
- ◯ HAS YOUR MANAGEMENT ENDORSED THE LOCAL BLOOD DONOR PROGRAM?
- ◯ HAS YOUR COMPANY GIVEN ANY RECOGNITION TO DONORS?
- ◯ HAVE YOU INFORMED EMPLOYEES OF YOUR COMPANY'S PLAN OF CO-OPERATION?
- ◯ DO YOU HAVE A BLOOD DONOR HONOR ROLL IN YOUR COMPANY?
- ◯ WAS THIS INFORMATION GIVEN THROUGH PLANT BULLETIN OR HOUSE MAGAZINE?
- ◯ HAVE YOU ARRANGED TO HAVE A BLOODMOBILE MAKE REGULAR VISITS?
- ◯ HAVE YOU CONDUCTED A DONOR PLEDGE CAMPAIGN IN YOUR COMPANY?
- ◯ HAVE YOU SET UP A LIST OF VOLUNTEERS SO THAT EFFICIENT PLANS CAN BE MADE FOR SCHEDULING DONORS?

Remember, as long as a **single** pint of blood may mean the difference between life and death for **any** American . . the need for blood is **urgent!**

NATIONAL BLOOD PROGRAM

GIVE BLOOD

...give it again and again

(*Continued from page 177*)

stages. Another important activity is electronic tube development.

Indicative of the equipment used in the tube laboratory is a mass spectrometer type of leak detector which is the most sensitive commercially available. It will detect leakage at the rate of one cc in 31 years. The glass vacuum system produces an extremely high degree of vacuum—within 7/10,000,000 of 1 per cent. The atmosphere is completely controlled to meet the specific requirements of tube manufacture. The tube storage and testing rooms are soundproofed so there can be no disturbance to testing instruments.

ESTABLISHES PROGRAM FOR LEASING EQUIPMENT

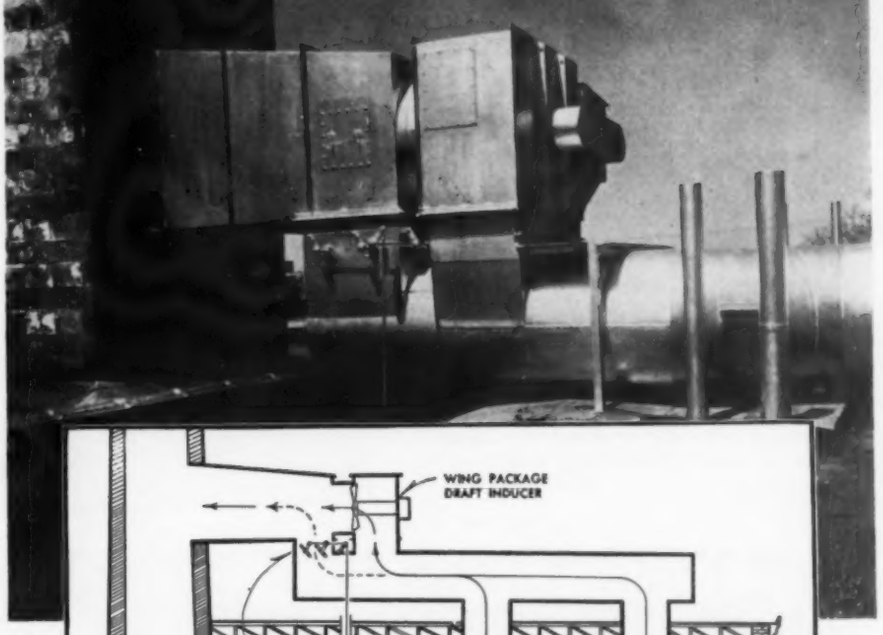
▲ Clark Equipment Co. has established a low-cost equipment-leasing program to operate through its dealers on a national basis. Financial arrangements for the program have been worked out with the Harris Trust & Savings Bank of Chicago.

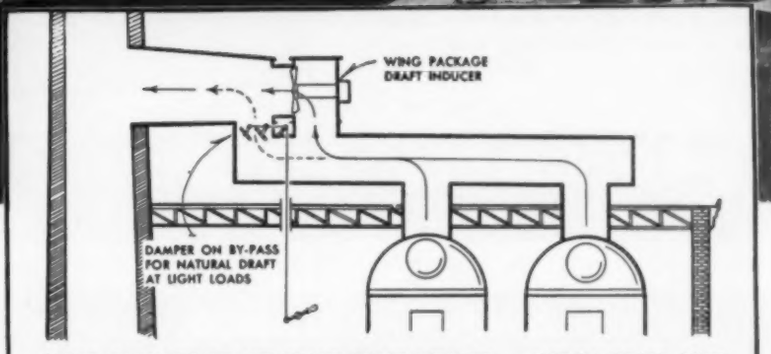
The program is not intended to promote the leasing of equipment in preference to outright purchase. It is being offered as a service to that segment of the industrial community which has need of a low-cost leasing arrangement. Such an arrangement is particularly attractive today because it frees working capital. Current high taxes, with little important relief in sight, means a "profitless prosperity," or a period comparable to 1946-49, when working capital requirements increased greatly.

The leasing arrangement offers at least a partial solution to the problem, since it avoids the necessity of expending any capital funds for there is no down payment or advance money required.

Under terms of the program, the dealer is the owner and lessor, with Clark Equipment Co. providing the direct financing. Equipment is leased to the customer for a three or a five-year period, with each annual rental, payable in monthly installments, being a declining amount based on the approximate rental value of a machine of varying age. Included in most lease agreements is the dealer's regular preventive maintenance contract. At the end of the three or five-year periods, the lessee has an option of extending the lease on a year-to-year basis.

The WING Package DRAFT INDUCER





WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

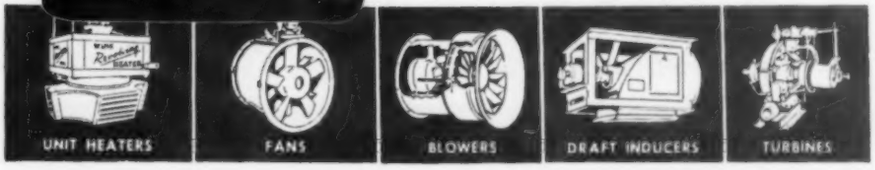
The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

Write for complete details

Wing

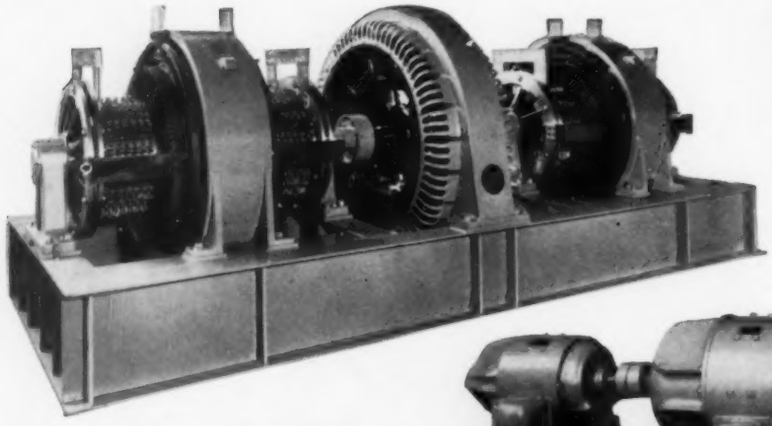
L. J. Wing Mfg. Co.
142 Vreeland Mills Road
Linden, New Jersey



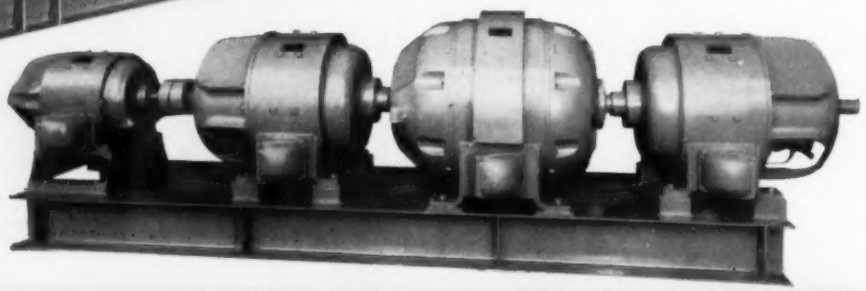
COLUMBIA

MOTOR GENERATORS

● Whether it be for continuous electrolytic tin-plating or electrocleaning lines, or for special power needs, Columbia builds Motor Generator Sets for your individual requirements. They're giving superior, around-the-clock performance in many of the country's leading mills. Illustrated here are typical installations of Columbia generators built to specification.



Two 7500 Ampere 24 volt, 3750 Ampere 48 volt, Separately Excited, Columbia D.C. Generators driven by 600 HP, 1.OPF, 360 RPM Synchronous Motor.



Multi-Unit Columbia Motor Generator Set consisting of two 50 KW, 250 Volt D. C. Generators, and one 10 KW, 50 Volt, 200 Ampere booster Generator, all driven by 200 HP, 0.8PF, 1200 RPM Synchronous Motor.

COLUMBIA ELECTRIC MFG. COMPANY

4543 Hamilton Avenue — Cleveland 14, Ohio

TOPS FOR PRODUCTION OF HIGH GRADE STAINLESS, ALLOY AND RIMMING STEELS

Heroult

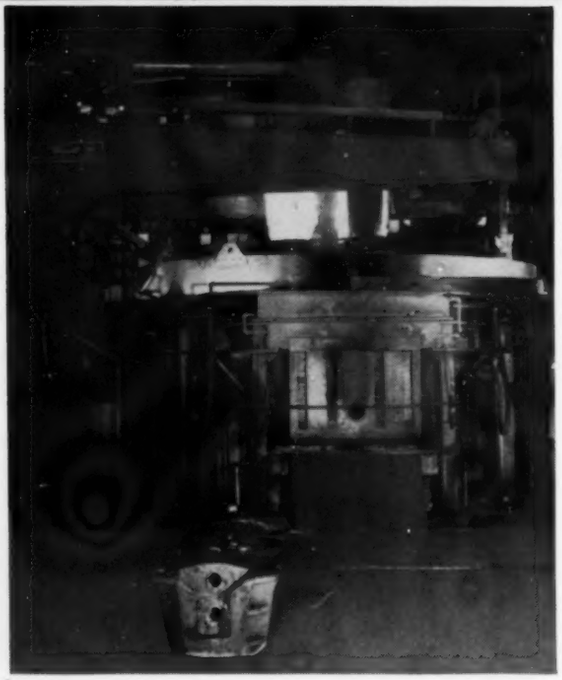
ELECTRIC MELTING FURNACES

EMBODYING the latest in mechanical and electrical equipment, these widely used furnaces are noted for their efficient performance and safety, and low operating cost and maintenance.

We welcome an opportunity to help you select and install the furnace best suited to your particular requirements.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

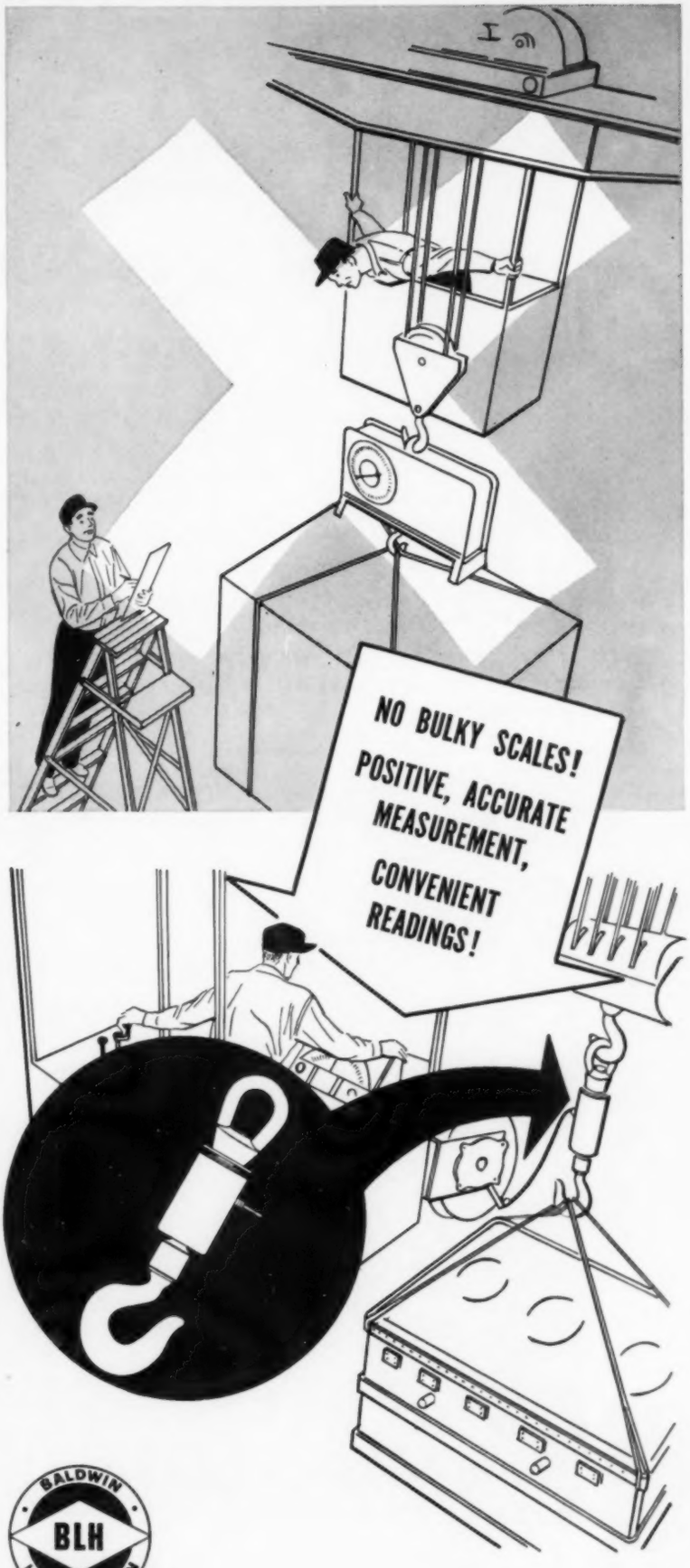
Contracting Offices in New York, Philadelphia, Chicago, San Francisco and other principal cities.
United States Steel Export Company, New York



Removable roof of new design now available for large furnaces.

USS

UNITED STATES STEEL



Weigh faster... more accurately... with a BALDWIN SR-4® crane scale

Overhead weighing need no longer be cumbersome, time consuming, dangerous or inaccurate. By replacing ordinary weighing devices with a Baldwin SR-4 crane load-weighing unit, you can have all the advantages of electrical weighing—the speed—the conveniences—the high accuracy—the freedom from hazards.

A simple unit, this new electrical weighing device consists of the SR-4 pick-up, the instrument, and cable reel if required.

The portable crane scale is simply hung on your crane hook—the Baldwin SR-4 Load Cell is hermetically sealed, temperature compensated and free from moving parts. This load cell offers a reliable, rugged, accurate system, hard to obtain with other weighing methods.

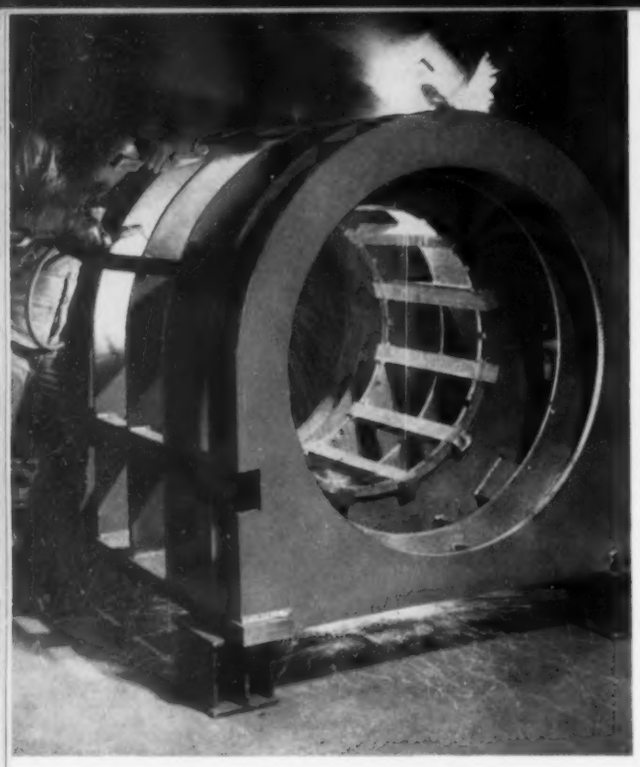
The electrical signal can be transmitted to indicators, recorders, or printers located either in the crane cab or at any other convenient spot in the plant. Readings are easily made—without danger to employees—without the usual inaccuracies and lost time. Baldwin SR-4 Crane Scales have Standard Capacities of 5, 12½ and 25 tons. Other capacities are available on special order.

For further information write for our new bulletin on crane scales. Address Dept. No. 3117, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pennsylvania.

BALDWIN BLH LIMA-HAMILTON

BALDWIN-LIMA-HAMILTON

Philadelphia 42, Pa. • Offices in Principal Cities • In Canada: Peacock Bros., Ltd., Montreal, Quebec



The a b c's of NEWEST large 2-pole Induction Motor Construction

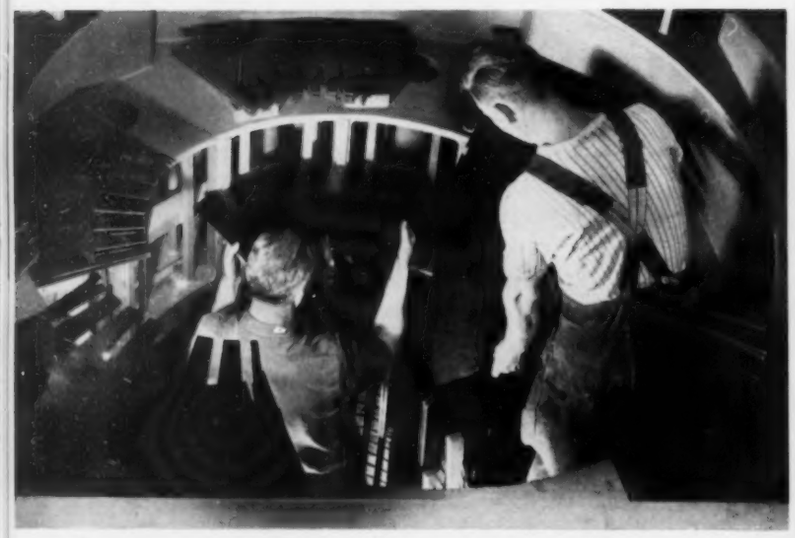
Here's a picture sequence showing a big E-M 2-pole boiler feedwater pump motor* in construction. Step by step you can observe the modern engineering and meticulous care given to every detail by E-M craftsmen. The little rhymes will call your attention to the key points in each picture.

As you know, requirements for big motors are exacting . . . the duty severe. Here you can see how E-M builds in extra quality to give you top performance, reliability, smooth operation and economy. The E-M sales engineer in your area has many more interesting facts on these big E-M Motors he'll be glad to tell you.

*E-M 2-pole Heavy-Duty Squirrel-Cage Induction Motor (1500 hp and larger)

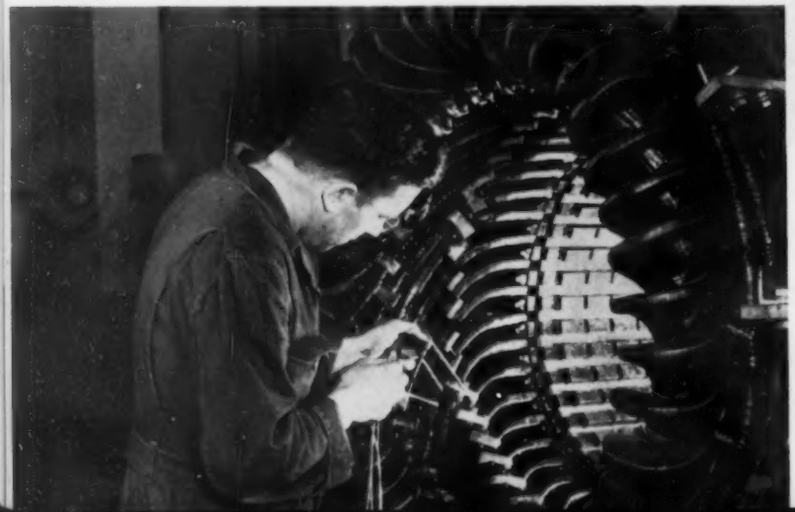
a

A's for All-welded, this reinforced frame;
It's made extra rugged to stay in the game.
All welds are continuous, tested for strength—
There'll be no distortion in width or in length.



b

Burrs are removed before laminations are stacked,
For a low-loss core that is true and compact.
The baked-on enamel coating of each lamination
Provides high dielectric strength and corrosion elimination.

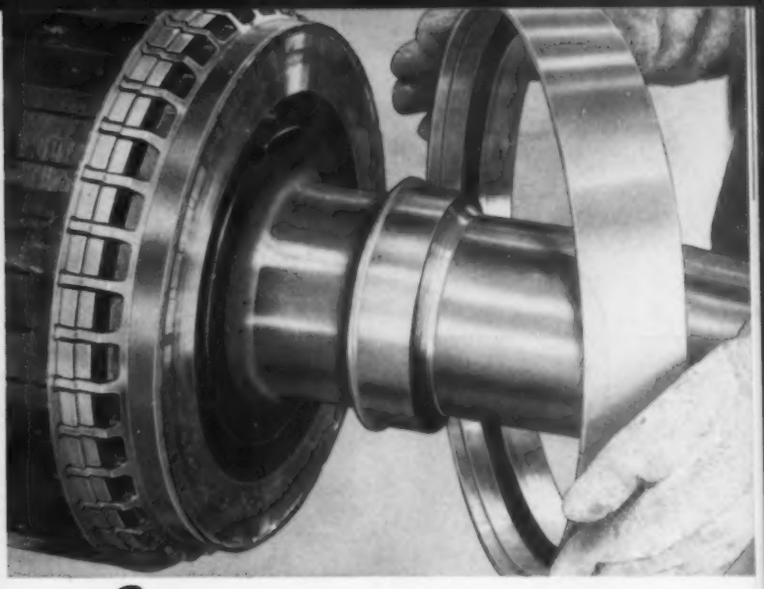


c

C is for Coils, with vacuum impregnation
To provide the best in protective insulation.
They're form-pressed to slot size to fit on the dot . . .
Each coil is surge-tested before reaching its slot.

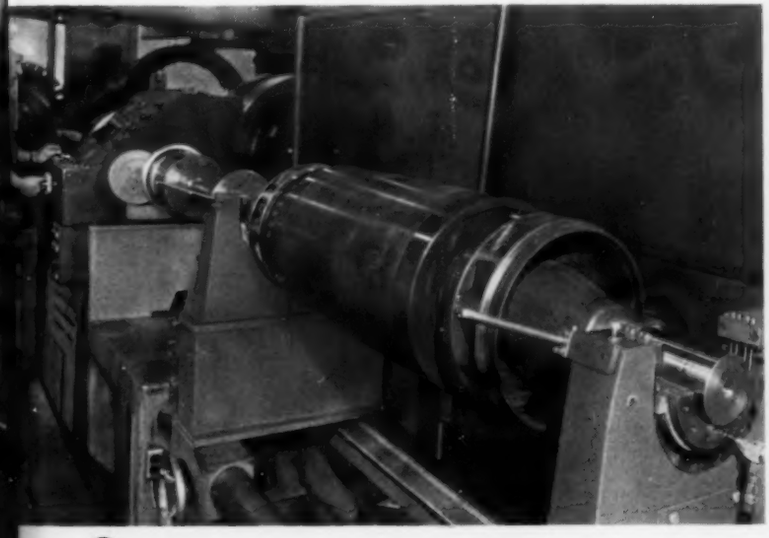
d

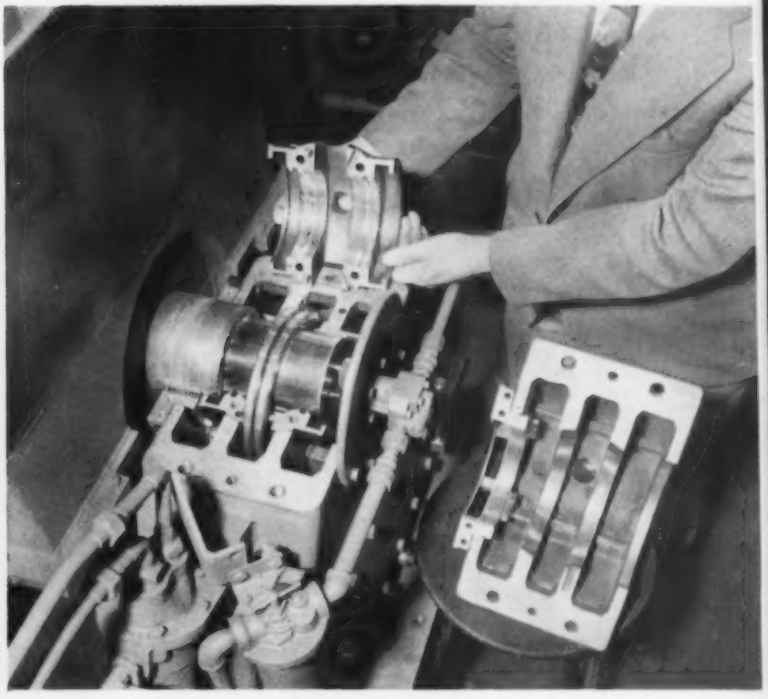
D is for Diligence in anchoring the winding . . .
Each coil side is lashed to provide an "arch" binding.
These tight E-M coil ends won't be twisting or parting
In any hard demand of full-voltage starting!



F is for Freedom from centrifugal force distortion,
In end-ring structure and retaining ring portion.
The cage bars fit rotor slots snug and tight—
Joints are silver-brazed; they stay just right.

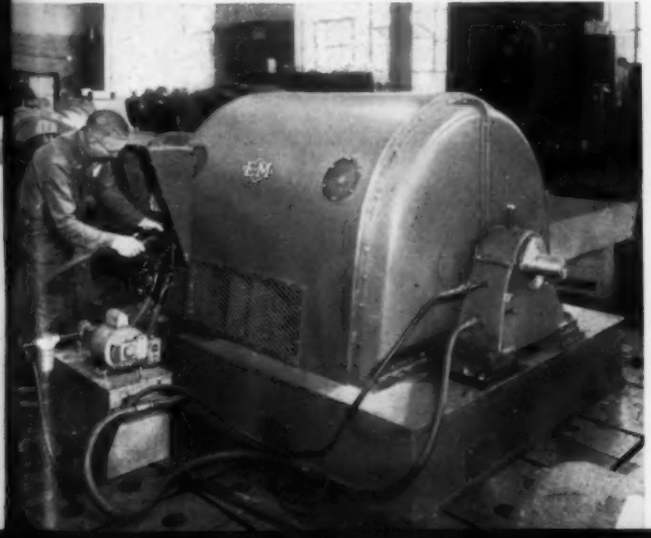
Extra protection for the E-M wound stator . . .
It's full-flooded with varnish—a real first-rater!
It's baked and re-flooded and re-baked at a pace
That seals the coil surface in every place.





G is for the Gisholt electronic machine
That checks rotor balance with an eye true and keen.
Again in the stator we check balance of the rotor
Because it's so important to a smooth-running motor.

High finish on journals, superfinish is the rule.
The bearings are well-sealed . . . they'll run long and cool.
The sleeves are Kolene-processed to last and last.
Double oil rings start lubrication safe and fast.



Inspection is thorough, when we've done all the rest,
For each E-M machine stands a rigorous test.
When it's installed in your plant, you know it can take it . . .
It's bound to be rugged, for it had experts to make it!

Like to know more about this 2-pole Motor beauty
For feedwater pumps or other hard-driving duty?
Just call your nearest E-M sales engineer now
For facts, data and application know-how.
Or write to the factory—there's much you can glean
From E-M's new brochure Number 214.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1300-TPA-2162

E-M

Specialists in making motors do exactly what you want them to

FOR *Top Performance*

DESCALE THE DREVER WAY

Drever descaling units provide top performance wherever they are in service. Applicable to both batch and continuous operation, they include, where desired—preheat furnaces, descaling, water quench, acid dip, and high pressure water rinse tanks, as well as complete instrumentation. Years of diligent research and development in descaling practice qualify Drever to meet your proposed operations.

Shown above is an annealing-descaling line for stainless steel strip. This unit has a capacity of 2000 lbs./hr. Maximum strip width 24 inches. Single strip, or multiple strips can be processed. These units can be built for any capacity and any width of strip.

8 tons of steel per hour is descaled in this 18 ft. caustic bath descaling unit. Operating with automatic temperature control at 930° F, this bath shows no appreciable drop in temperature after the load is charged.

DREVER CO.

730 EAST VENANGO ST. • PHILADELPHIA 34, PA.

Industrial Cut Gears

SET HIGH SERVICE STANDARDS THROUGHOUT THE STEEL INDUSTRY

Crane Trolleys, Roller Tables, Hoists, Shears, Lathes, Bar Mills and other Steel Mill Equipment are a few of the many applications for Industrial "Durocase" Gears.

"Industrial Gear" can take care of your heaviest requirements—Herringbones up to 61″ in diameter with an 18″ face—Spurs up to 102″ with companion Pinions, Bevels, Spirals, Worms and Worm Wheels and Mitres of all sizes, cut to exacting specifications.

Users everywhere report smooth, rugged, long life operation when "IG" Gears or "IG" DUROCASE (Steel Mill Type Gears) are on the job.

Why not consider "Industrial Gear" on the next order and note the difference in quality and service.

See how well our fully equipped plant can serve you. Write for Brochure "A Pictorial Trip Through Industrial Gear"—Bulletin No. 152-A.

Industrial Gear Mfg. Co.

4527 W. VAN BUREN ST.
CHICAGO 24, ILLINOIS

HAGAN

AIR-OPERATED CONTROLS

wherever STEEL

For more than thirty-five years, Hagan Corporation has been a pioneer in the design, development and application of automatic control and instrumentation to suit the changing requirements of the steel industry.

Their success may be measured by the fact that, wherever steel is made, Hagan Air-Operated Automatic Controls and Ring Balance Instruments are found, as well as by the number of customers who come back to Hagan whenever remodeling or new construction demand more control and instrumentation equipment.

The following examples are only a few of the many pioneering installations made by Hagan Corporation.

1. In one plant, we have installed automatic control of air delivery from a blast furnace blower. The control is actuated by a Hagan Ring Balance Meter, which is automatically compensated to correct for barometric pressure and air temperature changes. The control adjusts turbine speed only, requiring no control valves or dampers in the blower discharge. This same plant has been a Hagan customer for twenty-five years. Hagan equipment is controlling coke oven crossovers and exhausters, blast furnace gas fired boilers, coke breeze fired boilers, blast furnace stove burners, and a new boiler unit burning blast furnace gas and pulverized coal, using the gas as available.

2. This example is a composite, representing the hundreds of installations of automatic control of fuel-air ratio for forced draft type blast furnace gas burners for stoves and boilers. This single development, in which Hagan equipment played a prominent part, pioneered the way to more efficient use of blast furnace gas as a fuel.

3. Twenty-five years ago, we installed the first completely automatic combustion control for

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING FACILITIES

HAGAN
HALL
BUROMIN
CALGON

HAGAN

RING BALANCE INSTRUMENTS

IS MADE . . .

boilers fired with blast furnace gas and pulverized coal. Hagan pioneered both the equipment and the method. Today, there are dozens of similar installations where combination fuel firing is controlled automatically by Hagan equipment. In some cases, coal burners must be started or stopped. In other cases the auxiliary fuel must be operated at a definite minimum, with availability and load demand determining the use of the primary fuel.

4. This plant uses natural gas for fuel on a reheating furnace, supplied on the basis of a maximum allowable consumption. A Hagan Ring Balance Meter, equipped with automatic compensation for gas pressure and temperature, gives a direct reading in standard cubic feet. Paper work and approximate corrections are eliminated, and the exact amount of gas used is known at all times.

5. Blast furnace gas and oil, or coke oven gas and oil are the two fuel combinations used for the boilers of one steel producer. The Hagan Automatic Combustion Control System uses either gas, as available, and compensates with fuel oil for any gas deficiency. The system maintains fuel-air ratio for all the varying proportions of individual fuels.

6. The metering of oxygen supplied to automatic scarfing machines is a tough job for a flow meter. The actual flow cycle, up to maximum and back to zero, lasts about 30 seconds and repeats up to twenty-five times in an hour. The flow reading and the totalized reading must be corrected to standard cubic feet. The pressure compensated model of the Hagan Ring Balance Meter has been proved the most accurate and dependable meter available for this service.

In addition, Hagan has made many installations for the following diversified applications—

Furnace pressure control and fuel-air ratio control for reheating furnaces, soaking pits and open hearth furnaces—BTU input control for multiple-fuel firing of furnaces—Gas pressure and flow control—Blast furnace stove burner control—Gas flow measurement—Steam flow measurement—Gas density correction—Gas mixing station control—Automatic furnace reversal control—Steam pressure reducing and desuperheating—Boiler drum water level.

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

PROGRESS REPORT ON NATIONAL CARBON
TRADE-MARK
BLAST FURNACE LININGS

One out of every *three* blast furnaces in this country is now lined with "National" carbon. With this outstanding acceptance of carbon as a blast furnace refractory, let's take a look at its remarkable performance *over the long haul.*

Here are the facts:

- *23* "National" carbon-lined furnaces have each produced over *2* million tons.
- *5* of these have passed the *2 1/2* million ton mark.

These are all original linings — *and still going strong!*

Every year more "National" carbon goes in... more unit tonnages go up and costs come down... more operators learn what *smooth* operation really is.

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York, 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA:
National Carbon Limited—Montreal, Toronto, Winnipeg

NATIONAL CARBON PRODUCTS

CARBON LININGS FOR FERRO-ALLOY FURNACES • CARBON MOLD PLUGS • GRAPHITE THERMOCOUPLE SHEATHS • GRAPHITE STARTERS FOR HOT-TOPPING • CARBON CINDER NOTCH PLUGS • GRAPHITE AND CARBON CORES • GRAPHITE RISER RODS • CARBON BOXES AND GRAPHITE POWDERS FOR HEAT-TREATING • PIPE AND FITTINGS • CARBON BRICK • PUMPS • CONDUCTOR ROLLS • SPECTROSCOPIC ELECTRODES • STEAM JETS • ANODES

Personnel News...

Carl Gustafson has been appointed director of mechanical maintenance for the Colorado Fuel and Iron Corp. Mr. Gustafson will advise on mechanical problems arising in all of CF&I's 14 plants. In addition, he will continue to be superintendent of the mechanical department at the Pueblo, Colo. plant.

Joseph C. Anton has been named superintendent of construction at the Indiana Harbor, Ind., plant of Youngstown Sheet and Tube Co. Mr. Anton succeeds **Ed Haak** who retired some time ago.

Clifford A. Martin has been named construction engineer, engineering department at United States Steel's Fairless works near Morrisville, Pa. Mr. Martin joined Universal Atlas Cement Co., a U. S. Steel subsidiary, in 1946, as a construction engineer. In 1951 he was transferred to the construction engineering bureau and was one of the first engineers at the Fairless works site, arriving in January, 1951, two months prior to the groundbreaking. Since that time, Mr. Martin has participated in the construction of the big plant now nearing completion.

Michael R. Yatsko was named superintendent of industrial relations at Republic Steel Corp.'s warehouse division in Youngstown, Ohio. Mr. Yatsko succeeds Gordon J. Mitchell, who recently was named superintendent of industrial relations at Republic's Truscon Steel Division in Youngstown. In his new capacity, Mr. Yatsko will be responsible for all industrial relations matters in the division's Youngstown headquarters and 26 warehouses throughout the country.

Howard J. Davis has been named to head a newly established department to coordinate and expand product research and development for Colorado Fuel and Iron Corp. The new organization, a part of the executive department, will have headquarters at Washington, D. C. The new department is designed to further the corporation's product diversification objectives.

Frank A. Roberts was named manager of organization planning, a new unit in the industrial relations department of Youngstown Sheet and Tube Co., Youngstown, Ohio. Mr. Roberts has been serving as assistant to the Youngstown district manager.

Andrew J. Pratt, purchasing agent at Kaiser Steel Corp.'s Sunnyside, Utah, coal mine has been named senior buyer in the purchasing department of the company's steel plant at Fontana, Calif. Mr. Pratt's position will be filled by **Harry R. Bohme,** formerly assistant to the purchasing agent at the Fontana steel mill.

Albert F. Metz has been named chairman of the board and chief executive officer of Okonite Co., Passaic, N. J., **R. Stuart Keefer** has been elected president, and **Edward D. Youmans** becomes vice president in charge of research and product development. Messrs. Metz, Keefer and Youmans were respectively president, vice president in charge of sales, and vice president in charge of manufacturing and research. **Charles M. Kirkland,** formerly factory sales manager at the Passaic plant has been elevated to vice president in charge of sales, and **David W. Nurse,** previously resident manager of the Wilkes-Barre, Pa., plant, has been promoted to vice president in charge of manufacturing for the company's three factories.

Frank B. John was appointed general supervisor of training at United States Steel's Fairless works near Morrisville, Pa. Mr. John had been serving as a training engineer.

B. A. Kline has been appointed sales manager of the Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa. In his new office he will also serve as advertising manager of the company. Mr. Kline has been associated with Birdsboro in an estimating and sales capacity for the past 30 years. Before his appointment he was assistant to the vice president.

Henry A. Leilich has been named project engineer for the machinery division of Dravo Corp., Pittsburgh, Pa. His efforts will be directed primarily in the fields of power plant engineering and construction. Mr. Leilich was formerly a staff engineer with Peter F. Loftus Corp.

Stanley G. Harris was named general supervisor of costs and statistics for American Steel & Wire Division of United States Steel Corp., Cleveland, Ohio. Mr. Harris, goes to Cleveland from Waukegan, Ill. to assume duties handled until recently by **John W. Jordan,** who has been transferred to Pittsburgh to serve as assistant to executive vice president—accounting.

H. Stuart Auvil has been named director of the new coke research center at the Ashland plant of Semet-Solvay division, Allied Chemical and Dye Corp., Ashland, Ky. Mr. Auvil was associated with Citizens Gas & Coke Utility at Indianapolis, Ind., and more recently with Fuel Research Laboratory, Inc., Indianapolis, where he specialized in the selection of coals for coke ovens.

F. W. Wehrheim, a thirty-three year veteran with the Appleton Electric Co. has been elected its vice president in charge of sales. Mr. Wehrheim succeeds **E. A. Murray** who has resigned to return to his former employer, the American Steel and Wire division of the

United States Steel Corp. **I. W. Strong,** former Denver sales representative for the Appleton Electric Co., has been appointed assistant to the vice president in charge of sales.

Dr. Alexander R. Troiano has been named head of the department of metallurgy at Case Institute of Technology, Cleveland, Ohio. Dr. Troiano has been serving as acting head of the department since the death of **Professor Kenneth H. Donaldson,** former head, on September 3, 1953.

Edward G. Holtzman has been named as assistant secretary and assistant treasurer of Wagner Electric Corp., succeeding **L. W. McBride** who has accepted the position as executive vice president of Paxton and Gallagher Co. at Omaha, Neb. Mr. Holtzman has been serving as labor relations manager.

Charles W. Punton has been appointed director of engineering of Mine Safety Appliances Co., Pittsburgh, Pa. Mr. Punton has been with the company since 1929. He started as an industrial engineer and, in 1941, was named works manager.

Edward L. Bohn has been named to vice president of Mullite Refractories Co., Shelton, Conn. Mr. Bohn joined Mullite in 1952 as research consultant on furnace maintenance and construction. He was formerly with the Charles Taylor Sons Co., and North American Refractories Co.

Gordon J. Mitchell was named superintendent of industrial relations at Republic Steel Corp's., Truscon Steel Division in Youngstown, Ohio. Formerly industrial relations superintendent at the company's Warehouse Division in Youngstown, Mr. Mitchell succeeds **Walter C. Stoner,** who has been named an assistant superintendent of industrial relations at Republic's Youngstown steel plant. In his new capacity, Mr. Mitchell also will be in charge of industrial relations at Truscon's Canton plant.

V. L. Towner has been appointed industrial sales representative of the Cleveland, Ohio, district for Cuno Engineering Corp. The Cleveland territory includes northern Ohio. Since 1948, Mr. Towner has been assistant general manager of George P. Dempler Co. in Pittsburgh, Pa., selling Cuno industrial filters and related products.

Frank F. Mulkey has been appointed manager of the St. Louis, Mo., office of Falk Corp. Mr. Mulkey has been with the St. Louis office since 1951.

M. H. Hobbs has been appointed manager of Westinghouse Electric Corp.'s switchgear division, East Pittsburgh, Pa. Mr. Hobbs succeeds **J. B. MacNeill,** who joins the staff of the vice president in charge of industrial products. Mr. Hobbs has been serving as assistant manager of the switchgear division since March, 1953.

N. F. Diederich has been named as manager of engineering for Electric Products Co., Cleveland, Ohio. Mr. Diederich spent seventeen years with Clark Controller Co. where he last served as manager of engineering standards.

Charles M. Ruprecht has been appointed president of Electro-Alloys Division of American Brake Shoe Co. Mr. Ruprecht was formerly vice president of the division. He will be located at the Elyria, Ohio, plant.

Leslie B. Bellamy has been appointed general manager of the Sterling Abrasives Division of Cleveland Quarries Co. at Tiffin, Ohio. Mr. Bellamy has been Detroit, Mich., district manager for Sterling since 1946. He joined the division in 1944 as technical field engineer.

George G. Zipf was named superintendent of the steel plant of the Tubular Products Division of Babcock

GEORGE G. ZIPF

& Wilcox Co., Beaver Falls, Pa. Prior to his promotion, Mr. Zipf was assistant superintendent of the steel plant in charge of melting and blooming.

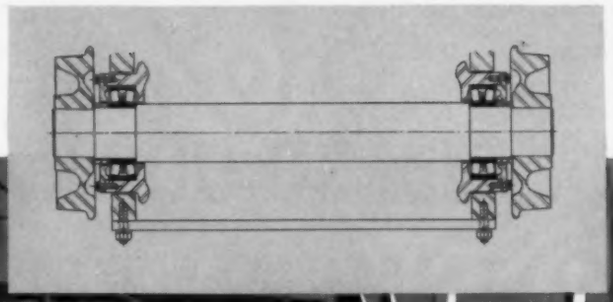
Russell A. Moore was named field applications engineer, specializing in side-loading fork truck applications for Baker-Raulang Co. Before joining Baker-Raulang, Mr. Moore was group engineer for Bell Aircraft Corp.

Paul C. McConnaughey was named sales manager of the Gas and Coke Division of Koppers Co., Inc., Kearny, N. J. For the past four years Mr. McConnaughey has been assistant manager of the Seaboard plant of the Gas and Coke Division in Kearny, N. J.

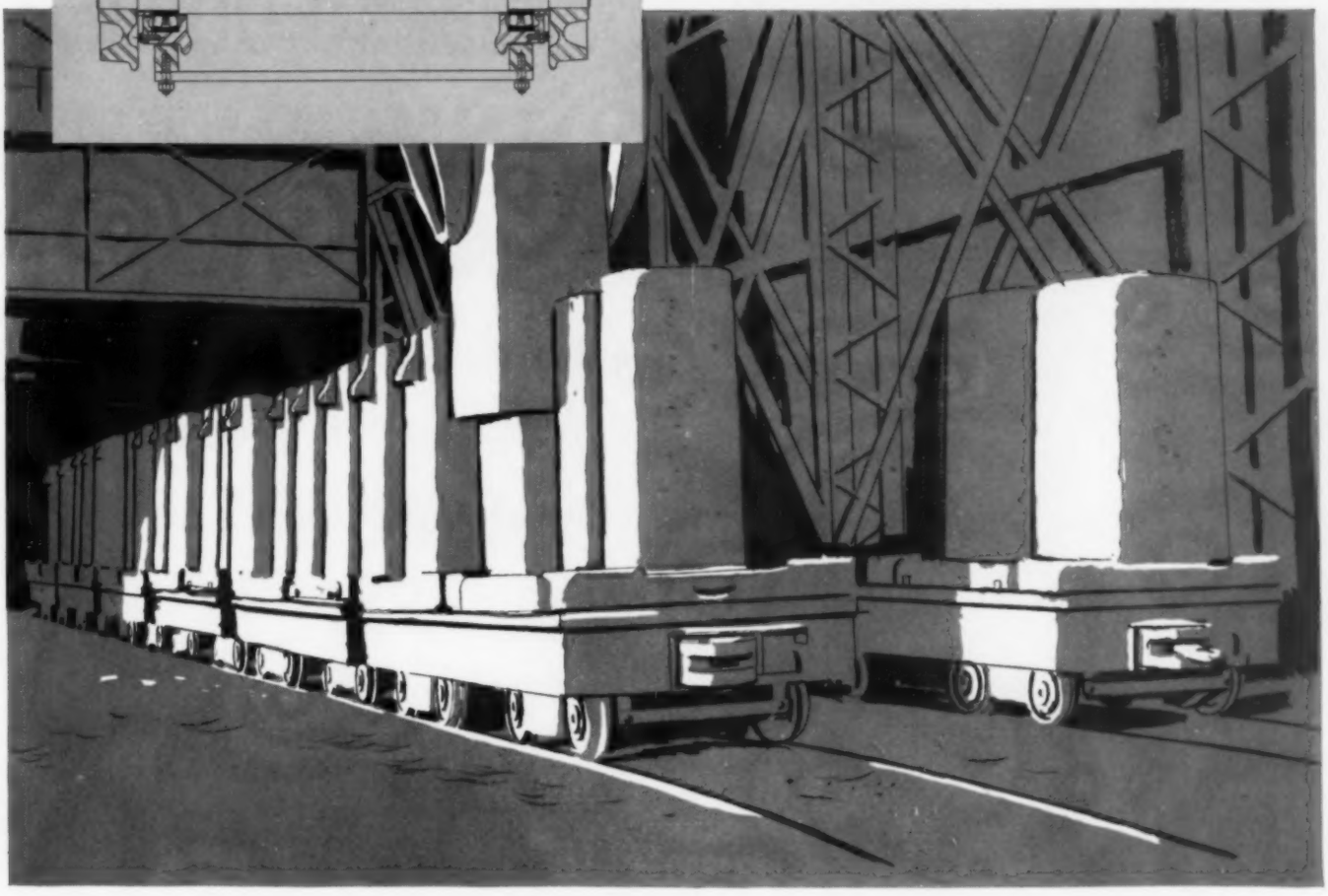
Thurman G. Thurston has been appointed by Selas Corp. of America as its representative in the Cleveland, Ohio, territory. Mr. Thurston will have his office at 1241 Commonwealth Avenue, Cleveland.

W. R. Wyckoff was named to the new position of assistant manager, midwest sales division, Townsend Co., in their Chicago, Ill., office. Mr. Wyckoff, who will as-

T O R R I N G T O N B E A R I N G S A T W O R K



Self-aligning, precision-ground TORRINGTON Spherical Roller Bearings step up rolling efficiency, help cut operating costs in Treadwell Construction Company's Ingot Mold Cars at Lone Star Steel Company.



For longer life at higher loads!

Load per wheel on the ingot mold cars shown above runs as high as 37,625 lbs.! That's the kind of application that calls for self-aligning, precision-ground TORRINGTON Spherical Roller Bearings.

These heavy-duty friction fighters are built from the finest of bearing-quality steels. They're carefully heat treated by the most advanced metallurgical procedures. Geometrical conformity between their races and rollers is of the highest. And their one-piece cast bronze cages (one for each path of rollers) are land-riding.

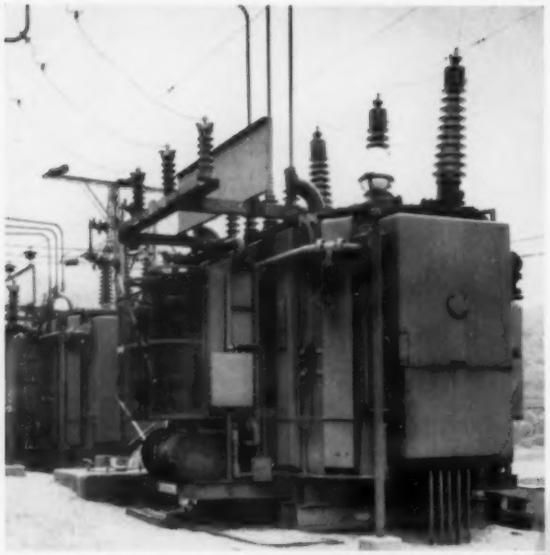
Thus they give you maximum load-carrying capacity, minimum rolling friction, and excellent resistance to wear and shock under the toughest operating conditions.

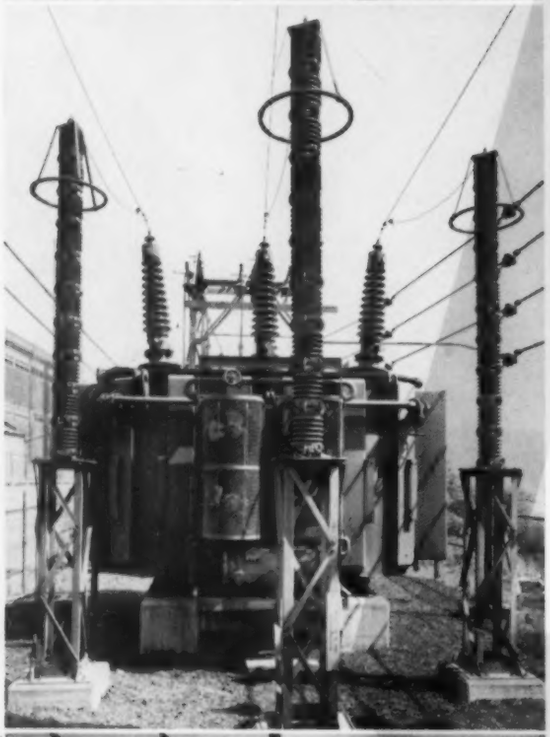
For equipment that carries heavy loads and where misalignment is a factor—specify TORRINGTON Spherical Roller Bearings. See for yourself why it pays.

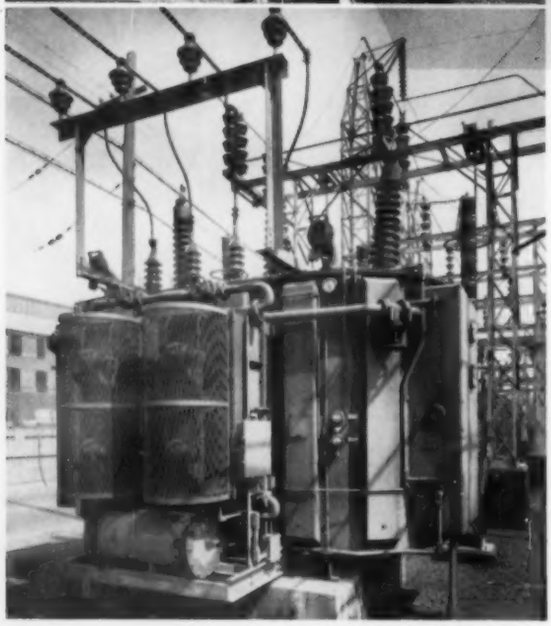
THE TORRINGTON COMPANY
South Bend 21, Ind. Torrington, Conn.

TORRINGTON SPHERICAL ROLLER BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers







...Four 30,000 kva PENNSYLVANIA TRANSFORMERS

supply the power requirements of the Brackenridge plant of ALLEGHENY LUDLUM STEEL CORPORATION

Each of these transformers is rated at 30,000 Kva, 3 Phase, Oil-Immersed, Forced-Oil-Cooled. Together, the four transformers supply 120,000 Kva of power to the Brackenridge Plant. But as usual, there is more to the story than the rating of the transformers.

Here are four transformers that were designed to rigid height limitations so they could be delivered by trailer truck to their installation sites. The voltage — 132 Kv — called for intricate engineering and strict attention to mechanical detail.

The first unit to be installed at Brackenridge illustrates how carefully the design was worked out. The transformer was trucked over 44 miles of first and second class highway and rolled off the trailer onto its foundation — all in one day. To reach Brackenridge, each transformer had to be light enough to go over bridges, small enough to go under viaducts, and properly distributed in weight to negotiate sharp curves with safety.

For a better picture of how this was done, we invite you to write us on your letterhead to arrange for a showing of our 16mm. black and white movie entitled "30,000 Kva En Route."

Pennsylvania Transformer Company

A McGraw Electric Company Division • **Canonsburg, Pa.**

GREATER PITTSBURGH DISTRICT

sume his new duties January 1, 1954, will be succeeded as sales representative in the Peoria, Ill., area by **Donald L. Byrne.** Mr. Wyckoff has been with Townsend since August 1, 1949.

George M. Hoffman has been named project engineer of Trion, Inc., McKees Rocks, Pa. Mr. Hoffman was formerly employed as assistant chief electrical engineer for the Peter F. Loftus Corp. and as design engineer for Ebasco Services Inc.

James D. Weber was named as a sales application engineer in the Detroit, Mich., district sales office of the Reliance Electric and Engineering Co. Mr. Weber joined the Reliance organization in July, 1952.

Richard Whitney has been named as sales engineer for Dixie Engineering Co., Birmingham, Ala. Mr. Whitney, over the past five years has been engaged in sales and service work in the states of Alabama, Georgia, Mississippi and Tennessee.

O. T. Henkle, Jr. has moved from the post of vice president-sales to executive vice president of Mercury Manufacturing Co., Chicago, Ill. **P. K. McCullough,** formerly vice president-manufacturing is now vice president-sales. **J. D. Appleberry,** who had been Mr. McCullough's assistant has been named plant manager.

F. E. Suder has been named manager of a new sales district covering Texas, Louisiana and Oklahoma for the Leschen Wire Rope division, H. K. Porter Co., Inc. The new district has headquarters in Houston, Tex. Mr. Suder has been with the Porter organization in various capacities since 1951.

Obituaries

Gustaf Leonard Fisk, 66, died in the Massachusetts General Hospital, Phillips House, Boston, Mass., November 4. Mr. Fisk lived in Pittsburgh during 1928, 1929, and 1930, during which time he was associated with the Mesta Machine Co. Since that time he has been living in New York, N. Y. Mr. Fisk was well known to the steel industry for his invention of the "Fisk Patented Cooling Bed," the first installation of which was made at the Midland plant of the Crucible Steel Co. of America during his identification with that company in an engineering capacity.

FIGHT POLIO!

JOIN THE MARCH OF DIMES

Modern RESOLITE Skylights for Allegheny Ludlum Steel Corp.

Resolite skylights amply daylight the West Leechburg, Pa. plant of Allegheny Ludlum Steel Corp.

Shatterproof, translucent, fiberglas-reinforced panels of Resolite are skylighting hundreds of modern plants. There are sound reasons for this popularity. Resolite's ease of installation, excellent light diffusing qualities and unlimited life make it the most practical and economical skylighting material for new or remodeled buildings.

Installation of Resolite skylights and sidewall lights is easy and economical because Resolite nests with all standard roofing and siding sheet corrugations, thus requires no special framing, flashing or caulking. It rests on the same members and is fastened by the same methods as metal or asbestos building sheets.

Skylights are formed in existing buildings merely by substituting Resolite for old building sheets and refastening. Sidewall lighting of non-corrugated buildings with Resolite is also easy, since sash is eliminated and simple angle girts used for support.

Resolite is manufactured of stable polyester resins, reinforced with a two-ounce blanket of glass fibers. It can be sawed, nailed, or drilled with ordinary tools and without special skills.

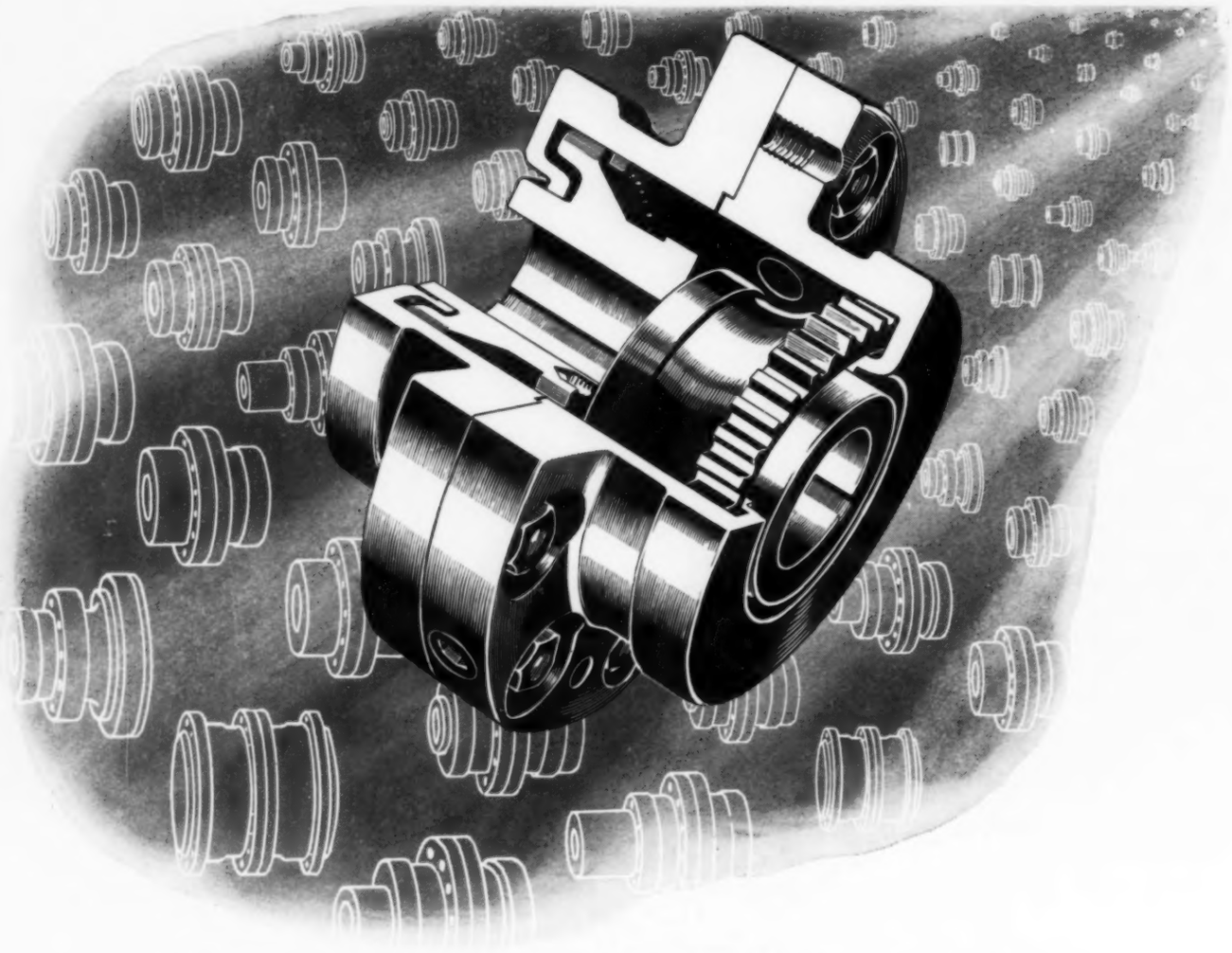
The evenly diffused daylight obtained in a building skylighted with Resolite gives workers greater visual comfort and safety . . . cuts artificial lighting costs.

Flat sheets of Resolite for window or door sash withstand severe vibration and impact without cracking or shattering. They are factory-cut to size and are installed with conventional glazing methods.

Send For New Industrial Skylighting Folder and the Name of Your Nearest Distributor.

RESOLITE CORP.

Box 516, Zelienople, Pa.



Hundreds of thousands of installations prove . . .

FAST'S Couplings are FIRST!

There's no stronger endorsement of Fast's Couplings than the close to three-quarter million Couplings installed in the 33 years since their design revolutionized the power coupling business!

Trouble-free performance that saves down-time, maintenance, and money led to that record. And, whatever your coupling applications, it's a guarantee of what *you* can expect from Fast's! Fast's Couplings give you *rugged construction* . . . because their original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest cost per year* . . . because they usually outlast the equipment they connect. And Fast's Couplings give you the benefit of Koppers *free engineering service* . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

Write today for full details to KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 312 Scott St., Baltimore 3, Maryland.

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THE ORIGINAL

FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

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BIG LIFT

FOR ALL INDUSTRY

MASSIVE RUGGEDNESS • POWERHOUSE STRENGTH • EASY HANDLING

These are the features that make STEARNS Circular and Rectangular Lifting Magnets successful and profitable in handling steel sheets, plates, bars, rails, slabs, billets, pig iron, castings, borings, turnings, scrap iron, or finished products.

Move large quantities of material fast — at low cost — with a STEARNS Lifting Magnet. It will pay for itself quickly, require little attention, and will fulfill your requirements for economical, fast and safe movement of material.

STEARNS Lifting Magnets are available in standard and special sizes made to your specifications. Available in bolted or all welded construction. Write today for STEARNS Lifting Magnet literature.

1066

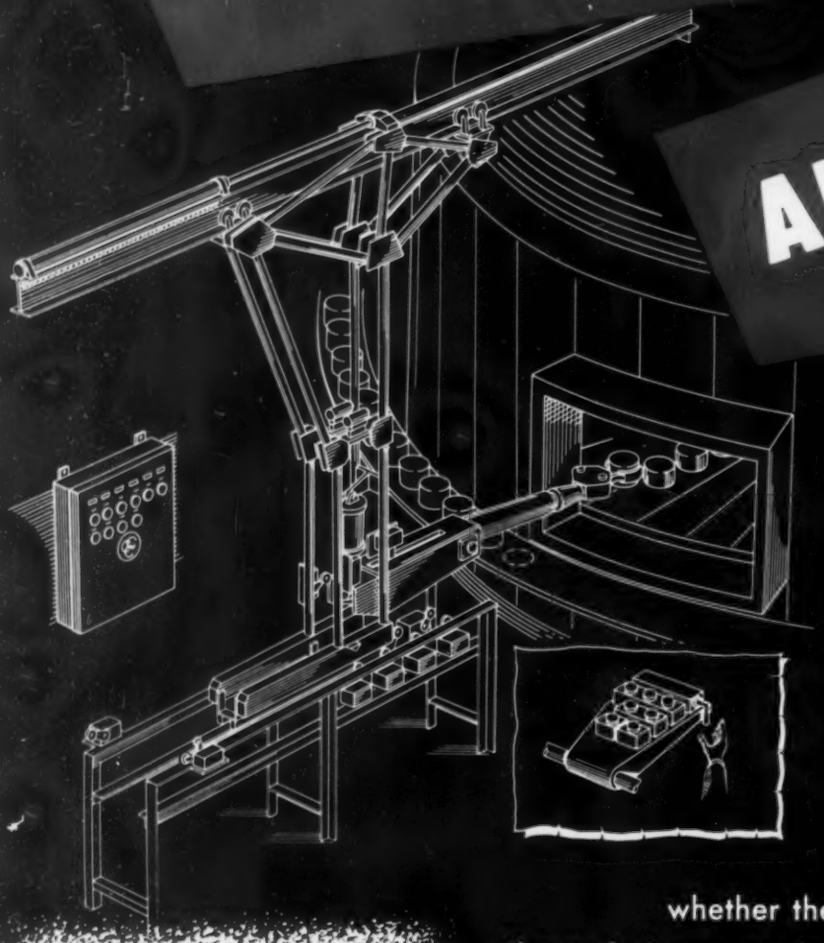
MAGNETIC EQUIPMENT FOR ALL INDUSTRY

STEARNS MAGNETS

STEARNS MAGNETIC, INC.

681 South 28th Street • Milwaukee 46, Wisconsin

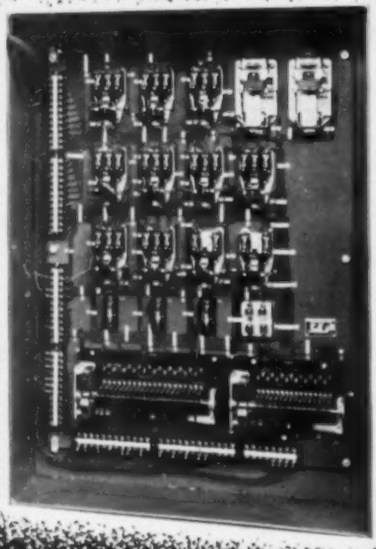
How's This For — AUTOMATION?



This mechanical hand is called a Billet Charging Machine. It automatically loads cylindrical steel billets into a rotary furnace, one row at a time, to be heated for forging.

The machine picks up a billet from the conveyor and sets it down inside the furnace. It repeats this operation until it has lined up a full row of billets. A selector switch determines whether there shall be three or four billets to a row. The cycle is repeated when the furnace rotates to the next loading position.

Seven separate motions are required to load each billet. Thus the complete cycle involves either 21 or 28 individually controlled motions for the row.



The Billet Charger was designed by E. Homer Kendall, Consulting Engineer, of Alliance, Ohio and built by May-Fran Engineering, Inc., of Cleveland. The special automatic control panel — the brain of the machine — is Clark designed and Clark built.

You can put CLARK Engineered Electrical Control experience to work for you. Just contact your nearest CLARK representative.

THE CLARK CONTROLLER CO.

ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

Reduce

HOT STRIP RUN-OUT TABLE Maintenance

with Y&M

Ductile Cast Iron ROLLS

Resist Heat Check and Warpage
Exceptionally Good Under the Sprays

We invite your inquiries on table rolls or any other ductile cast iron castings up to 100,000 pounds.

The Youngstown Foundry & Machine Co.

OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY

Youngstown, Ohio

12

Rear view of an actual blast furnace installation showing 4 sections of a MULTI-DUTY Air Filter—Capacity of 105,000 cfm.

it takes **CLEAN AIR** to operate a blast furnace **AT A PROFIT**

The mighty volumes of air fed to the hungry blast furnaces of the nation are dependent upon a number of mechanical factors. One of these is the rotary compressor. And, despite their appearance, these big, rugged machines are vulnerable to the billions of tiny abrasive particles found in the air. If the intake air is not thoroughly cleaned *before* it reaches the impellers — minute abrasive dust particles are intercepted by the impeller blades and their abrasive action will quickly wear the blades, resulting in "down time" for repairs.

The AAF MULTI-DUTY filter has proved the solution to this problem. These time-tested units have been performing reliable and economical service in some of the nation's biggest steel mills for years. They remove dust and dirt particles from the intake air before it reaches the impellers. Thus costly replacements and "down time" are minimized and efficiency is maintained when the MULTI-DUTY automatic air filter is on the job. To get the facts about the AAF MULTI-DUTY filter — please write for Engineering Bulletin No. 241.

AAF

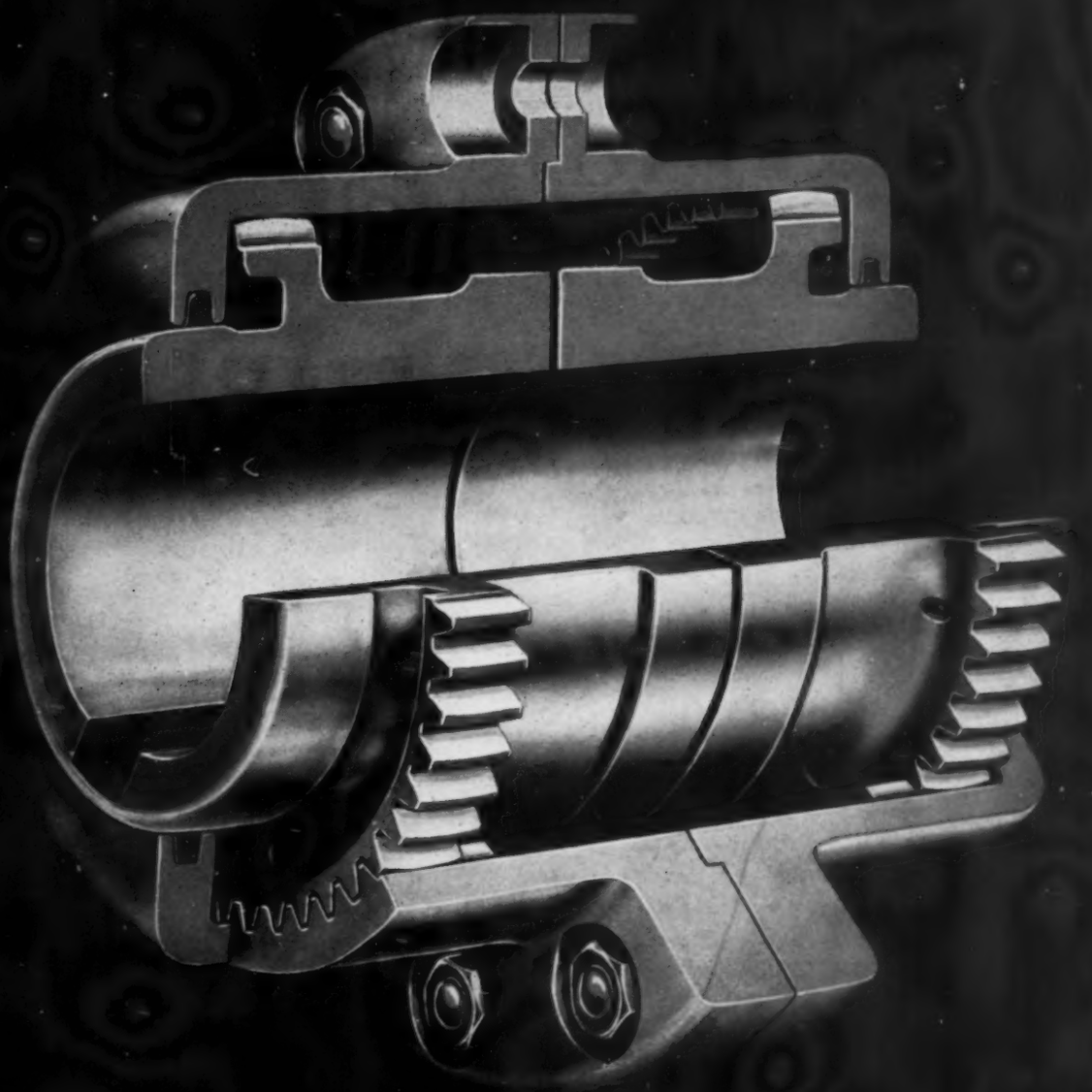
American Air Filter

COMPANY, INC.

302 Central Avenue, Louisville 8, Ky.

American Air Filter of Canada, Ltd., Montreal, P. Q.

POOLE

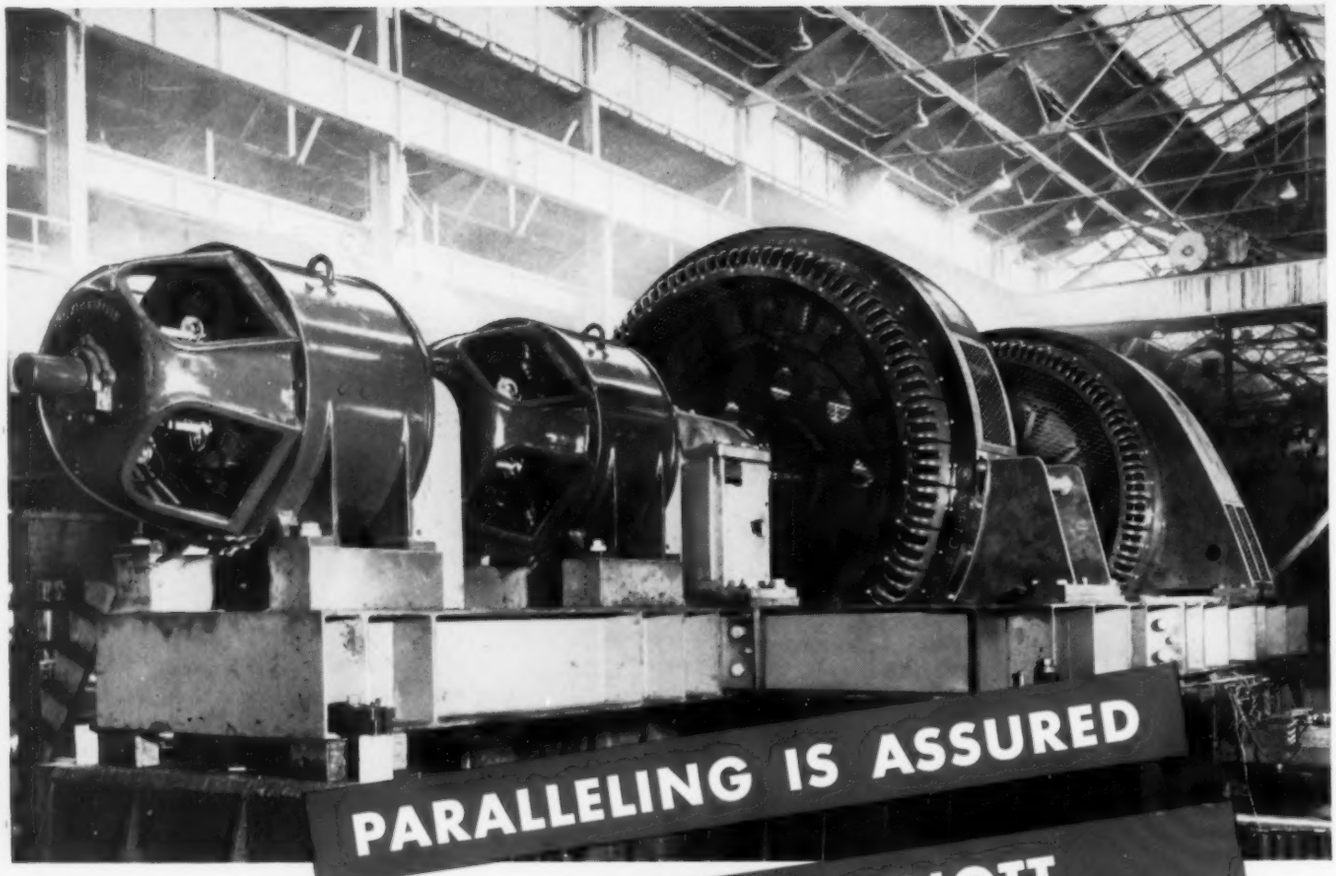


A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

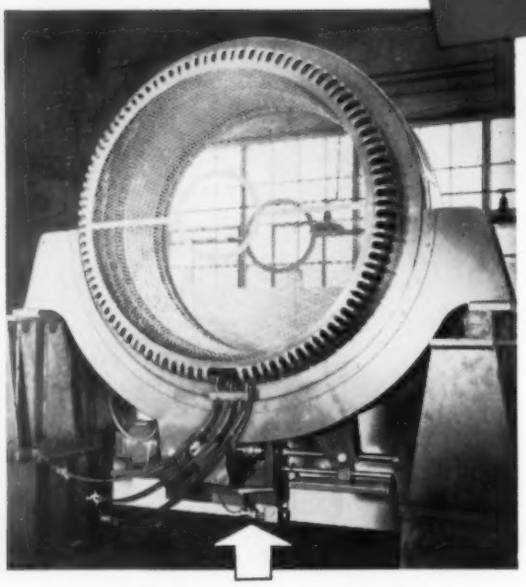
POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.



PARALLELING IS ASSURED WITH ELLIOTT

Synchronous Frequency Changers



A close up of the motor-driven shifting mechanism by means of which the generator stator is shifted by rotation in a cradle to establish the correct angular position for synchronizing. The stator shifting mechanism is furnished in one "package," making it readily removable as a unit assembly for convenience in maintenance.

• This large Elliott Synchronous Frequency Changer is one of a pair which operate in parallel while converting electric power from 25 to 60 cycles in a large Midwestern steel mill. Each set, with individual exciters for motor and generator, has an output of 1250 kva at 60 cycles. Paralleling is an assured, positive operation with this Elliott "team" because of careful design and precision workmanship. These essentials to performance are characteristic of all Elliott electrical equipment. For details write Elliott Company, Ridgway Division, Ridgway, Pa.

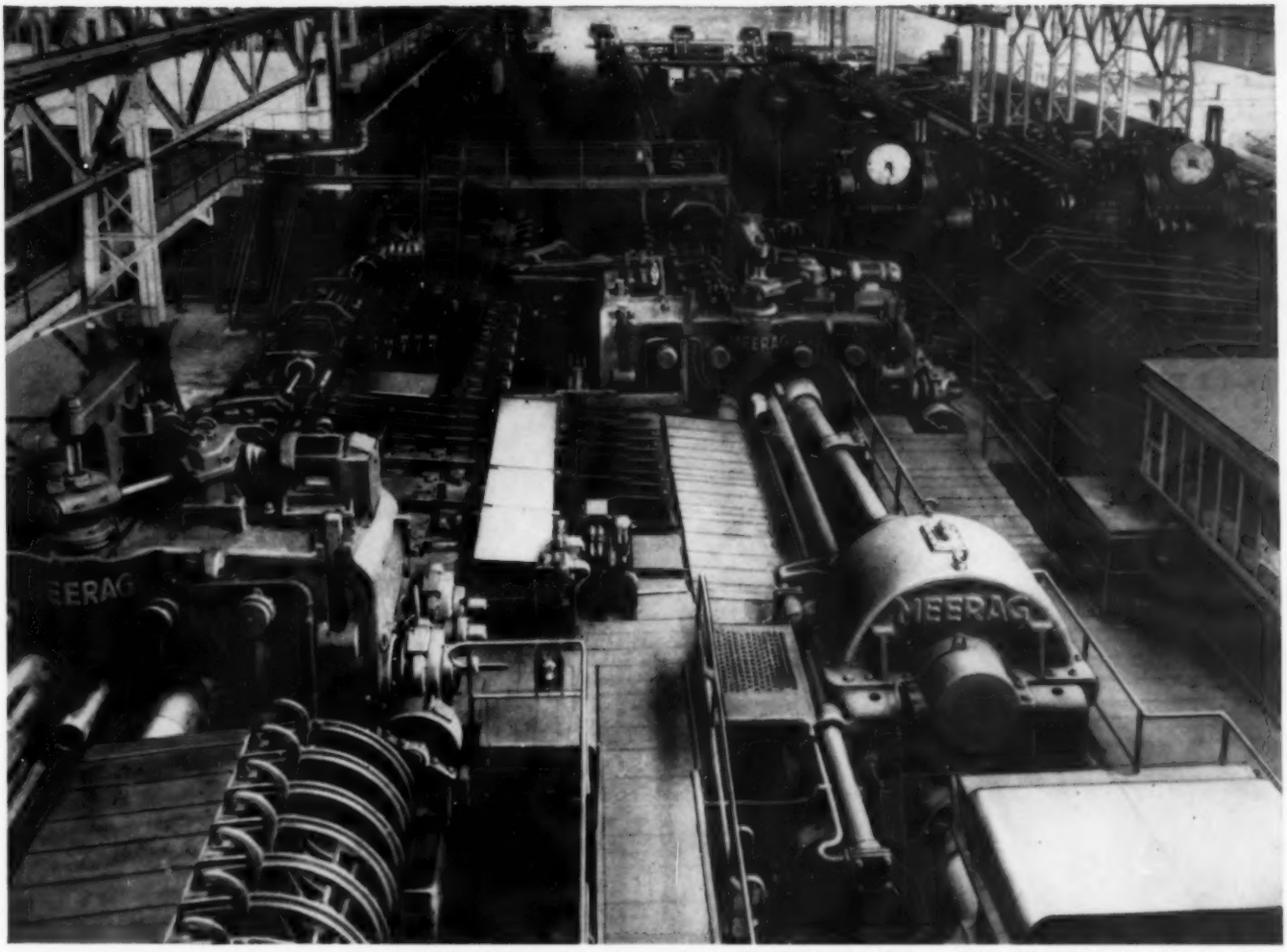
Elliott FABRI-STEEL MOTORS AND GENERATORS

R3-20

ELLIOTT Company

RIDGWAY DIVISION

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.



WORLD'S FIRST automatic seamless mill equipped with two plug mills (shown at upper right).

Seamless mill cuts costly down-time

• This well-known seamless tube mill had to find a way to make quick changeovers from one operating schedule to a radically different one. Mannesmann-Meer engineers solved the problem by installing two plug mills — the first time it had ever been done in an automatic seamless mill. The idea enabled the operators to cut costly down-time in half.

Here's a typical example of Mannesmann-Meer's ability to meet the growing need for extreme flexibility and versatility in tube mill operation. We're the only seamless mill manufacturer that can draw on years of experience in *mill operation.* This unique background makes Mannesmann-Meer best qualified to meet your seamless mill requirements.

Write us about pipe and tube mill equipment, mechanical and hydraulic extrusion presses for steel and non-ferrous tubing or special shapes, cold straightening machines, hydraulic equipment or other special machinery.

M.3.6

MANNESMANN-MEER

ENGINEERING & CONSTRUCTION COMPANY
900 Line Street, Easton, Penna.

WORLD SPECIALISTS IN HIGH-SPEED TUBE-MILL MACHINERY

IT'S THE *Built-in Quality* THAT COUNTS!

Designed to fit your present resistor space

STEEL GRID RESISTORS
consistently prove their value in
STEEL MILL SERVICE

Write for Bulletin No. 500

By use of those durable raw materials . . . steel and mica, and the P-G exclusive features of design, these Steel Grid Resistors have the "built-in quality" to overcome factors which often cause resistor failures. Vibration, moisture laden or corrosive atmospheres have little effect on continuity of service. Try Post-Glover Resistors for heavy duty applications where resistors are subject to severe service . . . continuous "Trouble-Free" performance is assured.

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

•ESTABLISHED 1892•

221 WEST THIRD STREET, CINCINNATI 2, OHIO

DRAVO
CONDITIONERS SAFEGUARD HEALTH, ASSURE HIGHER PERFORMANCE AT THIS LARGE MIDWESTERN METALLURGICAL COMPANY...

To safeguard the health of crane operators and increase their alertness, and efficiency, a large midwestern metallurgical company installed Dravo Crane Cab Conditioners in the crane cabs operating over 6 submerged arc smelting furnaces. Dravo Crane Cab Conditioners provide constant year-'round ventilation, filter the air, and remove harmful dirt, dust and fumes. Crane operators' working conditions are greatly improved resulting in higher performance and increased efficiency.

No matter what radical temperature variations or atmospheric conditions occur in your industry, there's a Dravo Crane Cab Conditioner designed for your specific needs.

HERE ARE THE *Plus* ADVANTAGES DRAVO CRANE CAB CONDITIONERS AND COOLERS OFFER YOU

1. COOL AND CLEAN AIR SUPPLY
All self-contained and split-type Dravo Crane Cab Coolers are equipped with a forced-ventilation system, insuring a supply of cool air free from dust and fumes to the compressor motor.

2. RUGGED CONSTRUCTION
Dravo Crane Cab Coolers and Conditioners are supported by a structural steel frame of all-welded construction.

3. MAXIMUM VOLUME OF AIR
All units are equipped with centrifugal-type squirrel-cage fans which furnish maximum amount of air.

4. HIGH EFFICIENCY
Condenser discharge air exhausts directly into atmosphere, permitting lower operating temperatures within condenser section.

5. CONTROL PROTECTION
Heavy-duty industrial controls are enclosed in a forced-ventilation cabinet, free from dust and fumes.

6. COMPLETE LINE OF EQUIPMENT
Only Dravo has a complete line of crane cab coolers and conditioners. Interchangeable parts reduce inventory costs.

AVAILABLE FOR PROMPT DELIVERY. Installation of Crane Cab Coolers and Conditioners is quick and easy with a minimum of downtime required. Write for Bulletin RX-1301-80 or phone the nearest Dravo sales office and have our representative call on you.

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Dravo Building, Fifth and Liberty Avenues
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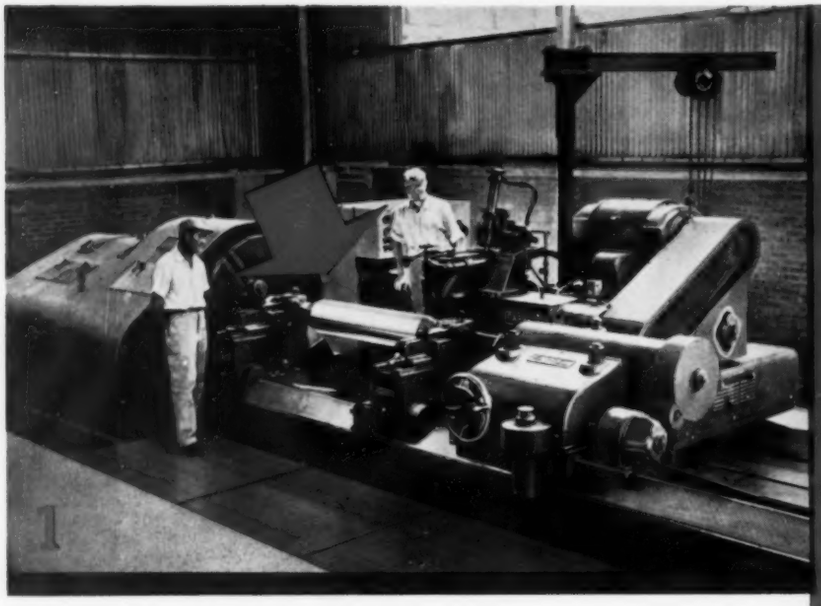

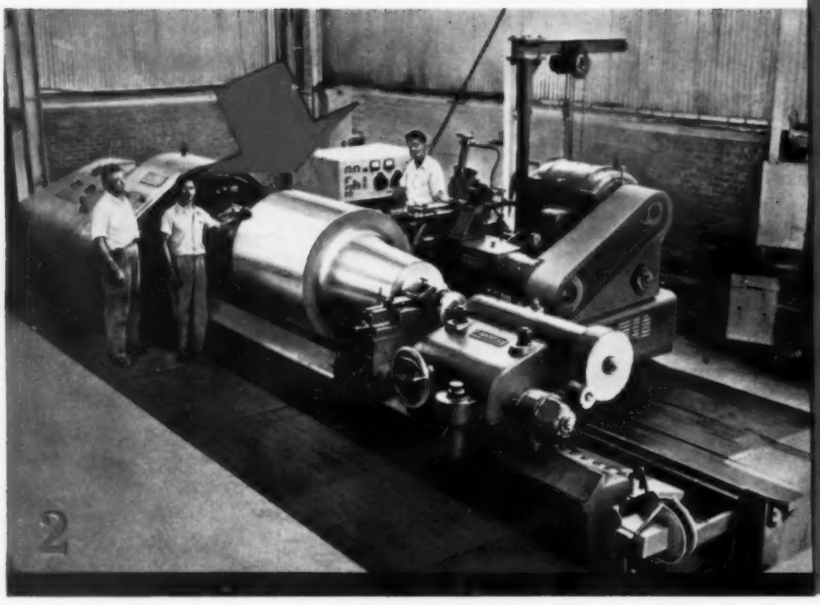

FARREL® ROLL GRINDER shows its versatility in Mexican steel mill

The above machine is a Farrel heavy duty roll grinder, size 44″ x 14′0″. It has shown its ability to grind rolls of widely varying dimensions and materials to any desired finish.

The small roll being ground in illustration No. 1 is a 10″ diameter work roll for a four-high mill which gives the skin or finishing pass to the metal. The large roll in No. 2 is a 46″ diameter backup roll for a four-high hot mill. This is two inches greater in diameter than the rated capacity of the machine.

The machine is owned by the steel mill of Hojalata Y Lamina and is in use at their Monterrey, Mexico, plant, located about 100 miles south of the Texas border. They say, " . . . the roll grinder has been doing excellent work. We are very glad we purchased it."

Farrel roll grinders are able to cut roll grinding time substantially and, at the same time, produce rolls with a perfect surface free from marks of any kind. The automatic crowning device produces a mathematically accurate curve, symmetrical on both halves of the roll, for either a convex or concave shape, without manipulation by the operator.

For more of the advantages of Farrel roll grinders, write for descriptive bulletin.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

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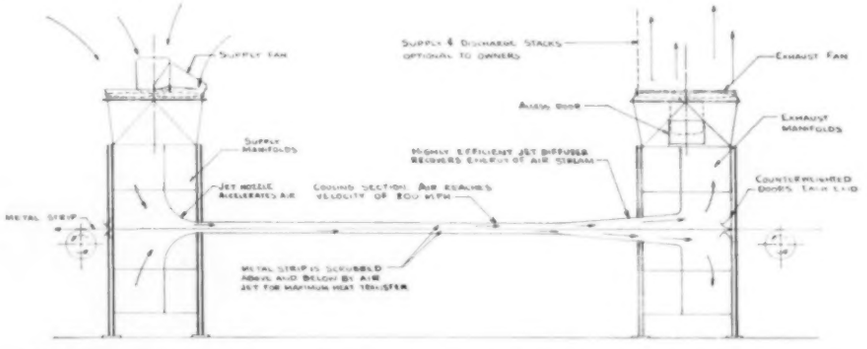
Farrel-Birmingham®

Equipment News...

WIND TUNNEL

▲ The increasing demand for steel strip has brought steel men the problem of how to increase the production of strip economically. To cool strip steel requires a lot of space. New buildings and new equipment are expensive, so are additions to old buildings. For these reasons steel mill operators have preferred to increase the production of strip through the use of existing buildings with existing equipment.

But, to increase the production of strip with existing facilities presents another tough problem, how can continuously annealed strip be cooled within the limits of present building space?


SUPPLY FAN
SUPPLY & DISCHARGE STACKS OPTIONAL TO OWNER
EXHAUST FAN
ACCESS DOOR
EXHAUST MANIFOLDS
SUPPLY MANIFOLDS
HIGHLY EFFICIENT JET DIFFUSER RECOVERS ENERGY OF AIR STREAM
JET NOZZLE ACCELERATES AIR
COOLING SECTION. AIR REACHES VELOCITY OF 800 MPH
COUNTERWEIGHTED DOORS, TAUT CLOSED
METAL STRIP
METAL STRIP IS SCRUBBED ABOVE AND BELOW BY AIR JET FOR MAXIMUM HEAT TRANSFER

Different methods of cooling have been tried — water spraying, roll cooling, water bath, etc. None has given the results achieved by simply passing the strip over a fairly long roll-distance where room air cools it satisfactorily.

This method, however, as any coiler operator can testify, is effective only at slow travel speeds. Double the speed and the operator has a difficult job handling more Btu's than he can take with any degree of comfort.

Engineers of the Iron Lung Ventilator Co. recently came to grips with this strip cooling problem.

Three installations have been made thus far, the most recent in a leading steel mill for flats and squares at straightening speeds from 50 to 200 feet per minute.

An outstanding feature of the machine is a new design of outboard bearings which makes roll change fast and simple while retaining machine strength approaching that of a unit with a double-housing. For roll change it is only necessary to loosen a single bolt for each bearing and when each is removed, the shaft is fully supported by the two main bearings.

The pass line consists of four bottom driven rolls with five top pressure or deflecting idler rolls. Pressure adjustments are simple, controlled by hand wheels at the top, easily accessible to the operator. The top roll housings are adjustable longitudinally on the base to provide for sharper deflection of small sections.

The top rolls have in-and-out adjustment along the center line of the roll shaft so that they may be staggered in relation to the bottom rolls and to each other for the correction of side camber in the stock being straightened. Ey using this in-and-out adjustment, results obtainable on a single-plane straightener can approach those of a two-plane straightener for a single pass of the material.

The same machine can be furnished as a two plane straightener or can be converted to two plane use at any time by addition of a separate unit which draws its power from the original motor.

Tearing a page from the wind tunnel designer's book these experts at air handling designed another kind of wind tunnel, one through which the hot strip would travel while surrounded by cooling air moving at high velocity.

This turbulent air stream accomplishes in ten feet as good a job of cooling as has previously been done by exposing the strip to room temperature for a distance of many hundreds of feet.

To achieve the highest efficiency the wind tunnel is designed with a nozzle that accelerates the speed of the air stream as it enters the cooling tunnel. Also incorporated is the latest design in diffusers to recover the energy of the high-velocity air stream. The result of this somewhat fanciful engineering is a highly satisfactory cooling tunnel that already has saved the cost of an expensive addition to an old building.

Several of these wind tunnels (for cooling strip up to 46 in. wide) are now in continuous operation at one of the leading steel companies, and are giving the utmost satisfaction. The units can be built to cool strip wider than 46 in. if desired. Power required is 20 hp for 46 in size, less for the smaller sizes.

CAB COOLER

▲ Progressive steel mill operators recognize the many advantages obtained by air conditioning the cabs of cranes operating in extremely hot areas or where toxic fumes are present. Numerous installations have proved that these advantages more than repay the installation cost on label cranes, converters, stripper and soaking-pit cranes, in hot strip and slab mills and in plants having blast and open-hearth furnaces. Because of the toxic fumes found in many alloy-steel plants, such as those producing manganese, chrome, silicon and beryllium alloys, an air conditioned crane cab also safe-guards the operator's health. This increased comfort means higher operator morale and efficiency, and less crane down time, therefore, more uniform production.

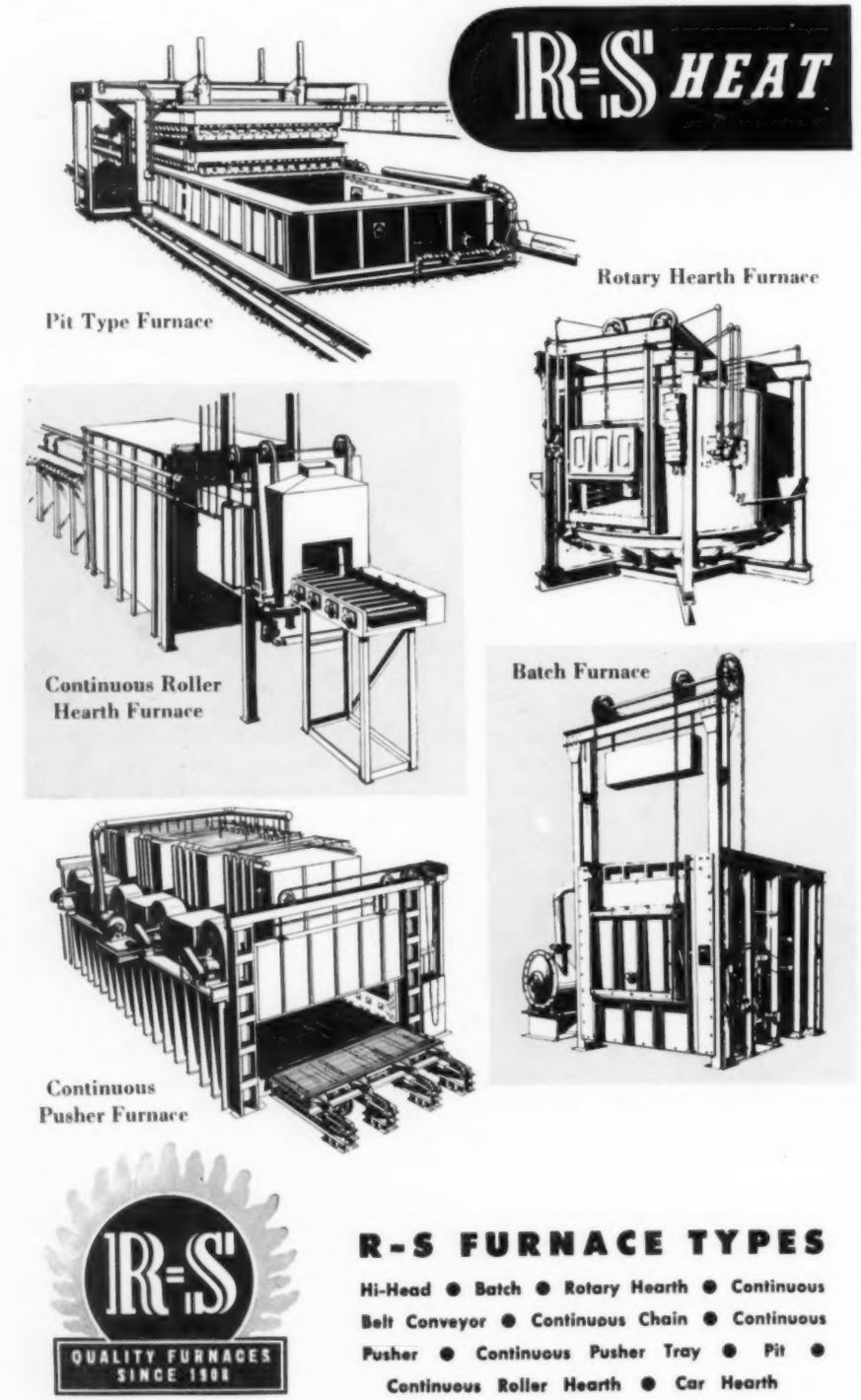
The reasons lie in the fact that a crane operator working in a high ambient temperature is subjected to artificially induced fever. As body temperature rises progressively to 102 degrees, a person will work fairly efficiently, but when this limit is exceeded, efficiency declines rapidly and the workman is liable to heat exhaustion, cramps, fatigue and headache. The only way to keep the cab at a reasonable temperature is to install mechanical refrigeration.

Such mechanical air conditioning

units which combine adequate refrigeration with an effective method for reduction or elimination of dust, dirt, fumes and gases, provide a highly satisfactory and economical way to maintain normal human efficiency and safe-guard the operator's health.

The split-unit type was recently selected by Jones & Laughlin Steel Corp. for one of its steel mills because of limited space on the crane. The condensing unit having the greatest bulk was installed on the crane bridge and the evaporator section in the cab. The two were then connected by the refrigerant piping installed in the field, which eliminated the use of duct work.

This equipment not only filters the air, removes dust, dirt and fumes, but also heats the cab in winter, cools it in summer and provides constant ventilation the year around. Comfortable working temperatures are maintained, namely, 80 to 85 degrees F in summer when ambient temperature is approximately 150 degrees F, and 68 to 72 degrees in winter when outside ambient temperature is zero.


R-S HEAT
Pit Type Furnace
Rotary Hearth Furnace
Continuous Roller Hearth Furnace
Batch Furnace
Continuous Pusher Furnace
R-S
QUALITY FURNACES SINCE 1908
R-S FURNACE TYPES
Hi-Head ● Batch ● Rotary Hearth ● Continuous Belt Conveyor ● Continuous Chain ● Continuous Pusher ● Continuous Pusher Tray ● Pit ● Continuous Roller Hearth ● Car Hearth

WORK ROLL

▲Mackintosh-Hemphill Co. is manufacturing a new work roll that may greatly simplify roll inventory practice in hot strip mills. The roll can be used in all stands of a hot strip mill finishing train.

Previously, spare rolls of two or three different hardnesses had to be stocked. That meant an inventory of possibly several hundred rolls for each strip mill. The new Mack-Hemp roll makes it possible to operate the mill with a minimum of replacement rolls on hand.

Fred C. T. Daniels, vice president in charge of metallurgy and research says, "It is like having one size of tire on the front wheels of your automobile and another size on the back wheels. Instead of carrying one spare tire, you would have to carry two."

The alloy iron roll, Mr. Daniels points out, is a modification of the tempered anniversary roll the company announced earlier this year.

The new roll is double-poured hard and then tempered. Under usual practice, rolls of this type are poured initially at the hardness desired and used in this condition. The Mackintosh process consists of casting the roll at a high scleroscope and then heat treating or drawing it back to approximately 76/78 scleroscope.

Heretofore it was though that 79/81 scleroscope rolls were a must in the finishers and 70/72 scleroscope in the early stands. Now roll engineers have discovered that the 76/78 scleroscope rolls can be used with good results in all finishing stands.

RARE EARTH ADDITIVE

▲ There has been a considerable amount of development work on the use of rare earth metals and compounds as an additive to stainless steels in order to increase their hot workability. The difficult to hot work stainlesses, such as 308, 309, 310, 316 and 317, have received much of these development benefits.

Recently, however, indications show that Molybdenum Corp. of America, in their development of the actual rare earth additive, has been able to incorporate the salts of rare earths along with reducing materials to improve the hot working quality of stainless and other low alloy and carbon steels. The economics of this work done with Molybdenum's rare

earth compounds are most favorable and compared with other rare earth products show definite savings.

Rare earths have been added to stainless steel, in high temperature alloys, low alloy steel, low carbon steel, nickel base alloys and nodular iron in these past few years.

The quantities of rare earths presently available are ample since the discovery of the world's largest deposit in California early in 1950. The development of this mine since that time has been progressively increasing production.

EXPLOSION-PROOF LAMP

▲ A new explosion-proof, rain-tight hand lamp weighs only 4¾ lb—almost half the weight and about half the size of previous lamps of its type.

Just introduced by Crouse-Hinds Co., only the globe guard, globe-holder, and cord connector housing of the lightweight lamp (type EVH 103) are aluminum. The lamp receptacle housing, aluminum on earlier models, has been replaced by a lightweight high-impact molded phenolic composition. Phenolic bone fibre, another strong lightweight material, forms the lamp handle.

Use of lightweight phenolic materials have reduced the weight of this explosion-proof hand lamp to 4¾ lbs.

The new lamp also has much higher impact-resisting qualities. Its globe is seated firmly against a metal flange by a heat and impact-resistant globe guard. Drop tests by Underwriters Laboratories and Crouse-Hinds technicians have demonstrated that the globe cannot loosen, even under severe shock. Explosion tests and twist tests—straining cord and cord connector — were necessary to be sure that the new lamp met or surpassed the National Electrical Code's four-to-one safety factor.

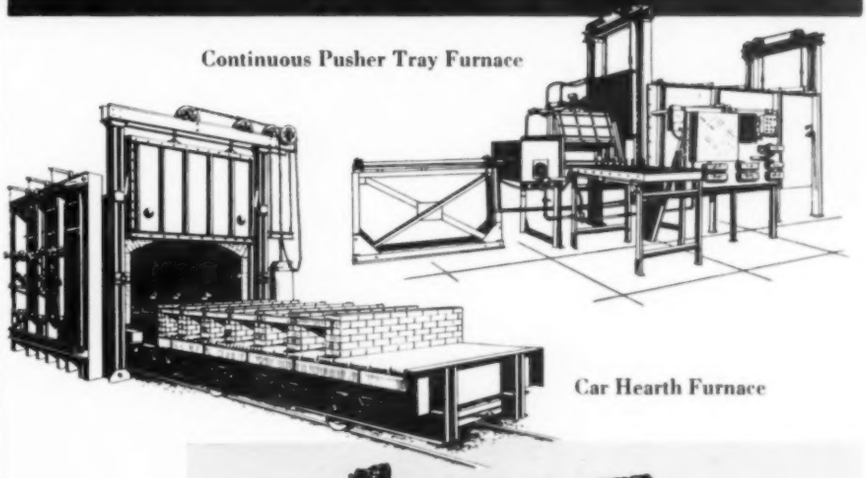
Both lamp chamber and handle are explosion-proof, separated by the lamp receptacle. But flame-tight joints, located along the globe-holder, handle and cord connector, prevent an explosion in one compartment from being transmitted into the other. These joints have five or more full threaded turns that after an explosion allow only cooled gases — not flames—to escape.

Another safety feature, the use of pressure type wire connectors in the cord connector assembly instead of soldered connectors minimizes the danger of wires being pulled free under the strain of continuous wear. Pressure type wiring also makes cord replacement easier because the cord connector entrance is more accessible.

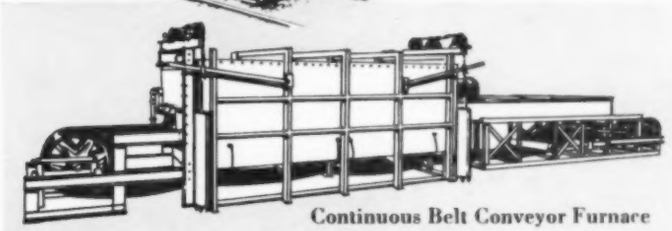
Rubber bushings are supplied with the fixture to accommodate ⅜-in. to

TREATING FURNACES

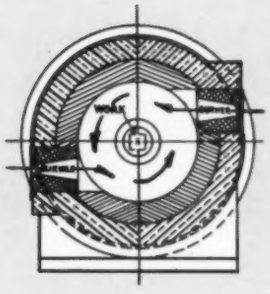
Continuous Pusher Tray Furnace



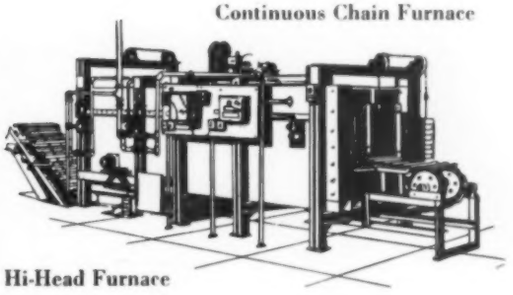
Car Hearth Furnace



Continuous Belt Conveyor Furnace



Continuous Chain Furnace



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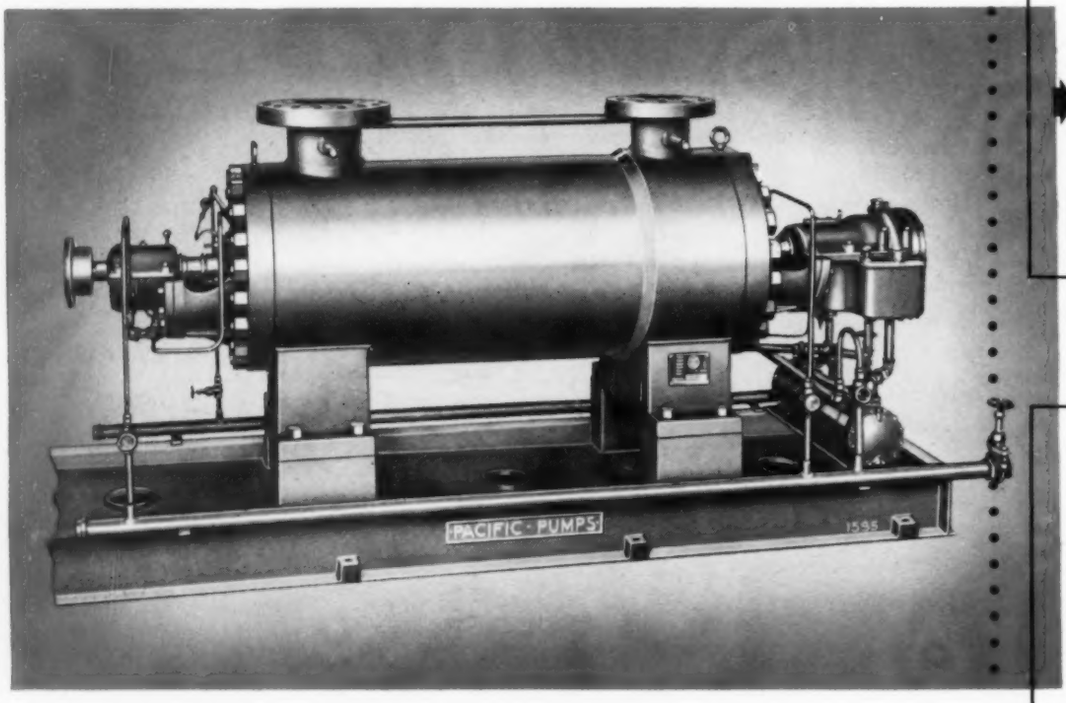
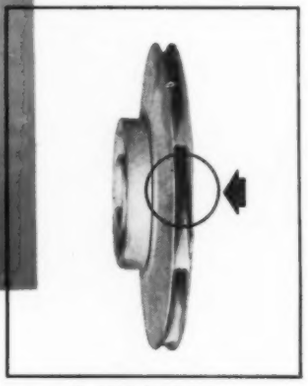


THE NEW
New impeller ready for installation.



THE WORN
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● *They will last and last . . . give you years of trouble free service!* Pacifics are built in types to meet your requirements . . . they will deliver up to 2700 gallons per minute of cold or hot water at discharge pressures up to 3000 pounds per square inch.

Their strength and toughness is created by using carbon and alloy steels. The bearings for multi-stage pumps are pressure lubricated. Bearings for all types are sealed against dust and dirt. The result is less down time, fewer replacements and much longer pump life. Pacific Pumps *set new service records*—time after time.

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York—

1S-1

5/8-in. portable cord. Besides forming a watertight seal, these bushings, together with a mechanical cable clamp, by gripping the cable tightly relieve strain on wire connectors in the cord connector assembly.

PETROLEUM COMPOUND

▲"Barcote No. 600," a new leaded petroleum compound developed for the protection of metal surfaces against corrosion, has been introduced by Brooks Oil Co. According to the manufacturer, this material is recommended for four basic types of applications: (1) corrosion protection of structural steel and sheet metal, (2) protection of rails, and rail joints, (3) lubrication of wire rope, and (4) protection of metal parts in storage.

The compound may be applied by either brush or air spray. A solvent, cut back, leaded compound, it provides coverage with a thin film which sets to a semi-hard coating of pure lubricant—with adhesion and penetration of all metals. Since the film is semi-hard and rubber-like in nature, it expands and contracts without flaking, cracking, pulling away, blistering or failing. In the 4 gram test on the Timken testing machine, this film carries 43 lb lever arm load for 30 minutes.

This material is said to be low in initial cost and to provide extended service. It will flow at 0 F, does not emulsify with water and has penetrating action sufficient to carry it behind scale and through rust. It does not evaporate in storage, never dries hard and has a strong affinity for metals. The compound resists the action of salt water, is soluble in petroleum solvents, never clogs spray equipment and may be filtered through a .005 in. mesh unit.

ROOF DECK

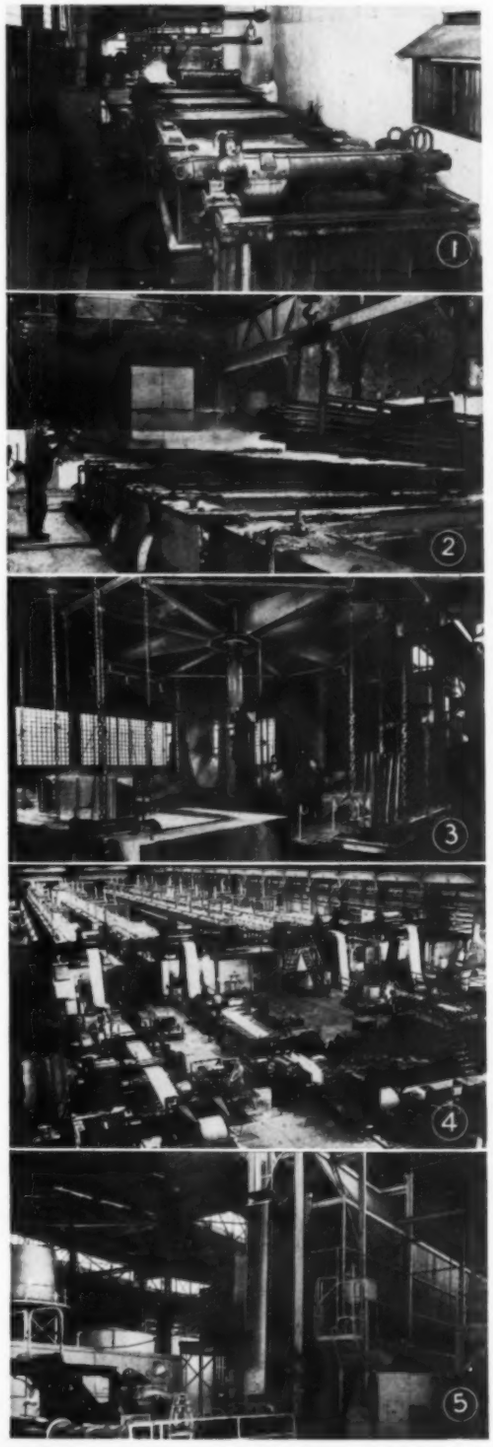
▲After three years of intensive research and field testing, Plasteel Products Corp. announced the nation's first protected metal roof deck for heavy industry.

"We have interpreted all of the advantages of our mica coated Plasteel roofing and siding into a roof deck that answers every construction problem and need in all atmospheric conditions," said Dr. J. E. Rosenberg,

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: EFFICIENT PICKLING WITH RODINE®



1. Rod and wire are pickled clean with "Rodine" without wasting either acid or metal. Breakage in drawing due to acid brittleness is minimized.

2. "Rodine" protects the exterior of tubes while completely descaling the interior and minimizes breakage in drawing due to acid brittleness.

3. "Rodine" makes possible the batch pickling of sheets over a wide range of acid concentration and temperature.

4. Whether sheet steel is pickled continuously or in batches, "Rodine" improves the surface and prevents "pickle burning" in prolonged pickling.

5. The absence of pitting and the smoother surface obtained with "Rodine" saves expensive coating metal in electrolytic tinning and galvanizing.

CHEMICALS ACP PROCESSES

WRITE FOR DESCRIPTIVE FOLDER ON "RODINE" AND INFORMATION ON YOUR OWN PICKLING PROBLEM.

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Detroit Steel Corporation - - - - - Portsmouth, Ohio
Electric Auto-Lite Company - - - - Port Huron, Mich.
Indiana Steel & Wire Company - - - - Muncie, Ind.
Jones & Laughlin Steel Corporation - Aliquippa, Pa.
Keystone Steel & Wire Company - - - - - Peoria, Ill.
Lamson & Sessions Company - - - Cleveland, Ohio
Mid-States Steel & Wire Company - Crawfordsville, Ind.
National Screw & Manufacturing Co. - Cleveland, Ohio
Pittsburgh Steel Company - - - - - - Monessen, Pa.
Reed & Prince Company - - - - - Worcester, Mass.
John A. Roebling & Sons Company - - Roebling, N. J.
Russell, Burdsall & Ward Bolt & Nut Company - - - - - - - Rock Falls, Ill.
Timken Roller Bearing Company - Gambrinus, Ohio
Washburn Wire Company - - - - - New York, N. Y.
Wickwire Spencer Steel Division - - - Buffalo, N. Y.

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY
3724 OAKWOOD AVENUE · · YOUNGSTOWN 9, OHIO

president, in announcing the new product.

According to Dr. Rosenberg, the roof deck was developed as a practical answer to the need for a superior decking with a built-in vapor barrier —that would permanently resist corrosive influences and high humidity conditions.

This new deck is manufactured by a special process that combines the structural strength of steel with three highly protective coatings—a bond coat; a weather-sealed asphaltic plastic coating; and a pure mineral mica topping. It has a wide application in every field of industry, especially for installations on paper mills, chemical plants and other buildings where corrosion and high humidity conditions prevail.

"We believe our roof deck has eight important features that insure longer life, less maintenance, and more protection," Dr. Rosenberg continued. "First and foremost is our built-in vapor barrier which eliminates additional layers of felt and tar under the insulation."

Dr. Rosenberg went on to point out that the roof deck has a sound absorbent surface that reduces dangerous reverberant noise prevalent in ordinary metal roof deck. Field painting is also eliminated by the factory coating of asphaltic-plastic with attractive mica surface.

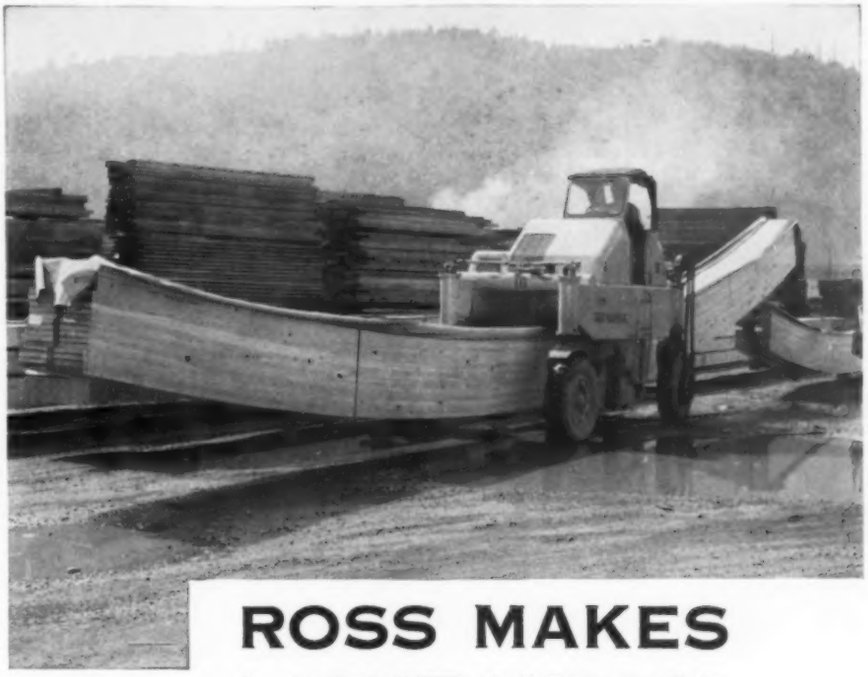
These roof deck panels are a full 24 in. wide, which results in greater coverage and takes less man-hours to install. The telescoping ends provide for snug nesting of end laps and give a smooth unbroken roof surface. The mica coating on both sides provides excellent light reflectivity and an attractive appearance to the underside of the deck.

The asphaltic-plastic coating into which the pure mica is embedded under heat actually seals itself at all joints and will eliminate the need for maintenance and periodic painting.

SHEET FLOATER

▲The magnetic sheet floater, developed by Dings Magnetic Separator Co., separates stacked steel sheets for easier handling.

The units operate on the principle that like magnetic poles repel. Sheets placed next to one, or between two sheet floaters, assume the polarity of



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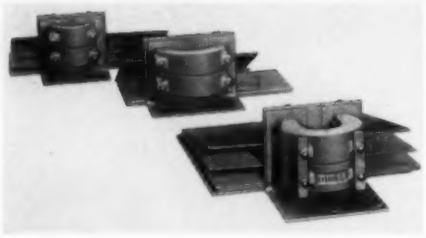
the magnet poles, repel one another, and fan out.

Top sheets in a stack are clearly separated from those below and are easily grasped. This eliminates fumbling with thin oily sheets. It minimizes the possibility of feeding doubles, protecting dies. And there is less danger of painted or finished surfaces being scratched.

The new series of sheet floaters are available in three basic magnetic strengths and four standard heights capable of handling 28 through 10 gage blanks up to 30 in. x 20 in. The units can be used singly or in pairs to handle sheets of almost any shape and stack of irregularly shaped sheets.

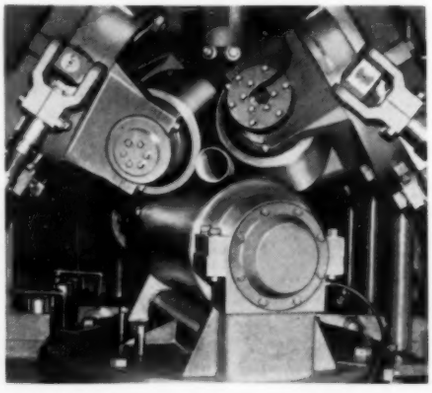


STRAIGHTENER

▲Accurate end-to-end straightening is assured by the advanced roll arrangement in a new tube and bar straightener announced by the Sutton Engineering Co. Listed as the "4 KTC," the straightener employs Suttons' exclusive seven-roll principle with cluster roll arrangement, which positively confines work to the pass line without guides.

To date two installations have been made. In an application at a large steel mill, a new straightener, equipped with a 150/200 hp, 300/1200 rpm adjustable speed d-c motor, is being used for 4½ in. outside diameter to 9⅝ in. outside diameter hot finished seamless tubing. Straightening speed on this unit has a 60 to 240 fpm range.

Designed for 3⅝ in. to 12 in. outside diameter tubes and bars from 3⅝ in. to 7½ in. diameter the new straightener may be readily modified to meet particularized needs.



Sutton's revolutionary cluster roll arrangement, introduced several years ago, employs a total of seven straightening rolls. A large driven roll with two opposed idler rolls is located at the entry end of the machine and another identical cluster is at the delivery end. In these clusters, rolls are positioned at approximately 120 degrees to each other. Between these three-roll clusters is an unopposed pressure roll. The arrangement eliminates the use of all guides.

Power operated screw downs and automatic coordinated angling of rolls cut the changeover time drastically; complete changeover from minimum to maximum size is accomplished in less than three minutes. Roll angles are automatically adjusted to the proper setting for the size of material being straightened, with full contact between work and rolls.

From a centralized control panel,

MEEHANITE® ROLLER TWIST GUIDES
Cast by Rosedale Provide
1. LONGER SERVICE LIFE
2. LOWER INITIAL AND MAINTENANCE COSTS
3. REDUCED DOWN TIME

TYPICAL of the Meehanite castings made by Rosedale Foundry and Machine Company to solve "tough" problems for the steel industry are the roller guides shown in operation above.

On billet and bar these rollers have set tonnage records ranging from 60 to 70,000 tons per pair. Their initial cost is a fraction of the materials which they have replaced. Maintenance costs and down time are at a minimum since these tonnages are being obtained without re-grinding or re-surfacing.

For further information on Meehanite roller guides, write for a copy of "Economies Effected in Roller Guide Applications". Specialists in the field of supplying castings to the steel industry, our Engineering Staff is available to help solve all your casting problems.

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AJAX DIHEDRAL couplings

Cut line-up time to minutes...

And that means you cut high down-time costs. Exclusive Ajax Dihedral tooth shape takes care of necessary misalignment between driving and driven shafts.

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Seals keep lubricant in and dirt out.

Write for full information.

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Least backlash

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the operator controls his main motor and his straightening speed, making his size adjustments by means of three motorized adjusting screws. The control pulpit, generally coordinated with table controls, gives a single operator control of overall straightening operation from a single pulpit.

MEASURING UNIT

▲An instrument especially designed for use with high-impedance detecting devices has been developed by the Minneapolis-Honeywell Regulator Co., Industrial division.

Incorporating a new input circuit the instrument will provide a wide d-c application potential. This is needed for installations which require an instrument with flexible operating characteristics where the source impedance, either fixed or variable, is in the range of 0 to 50,000 ohms. The amplifier of the instrument may also be separately used in many high impedance a-c servo applications.

The instrument has excellent overall stray rejection characteristics and the loading effect on the source is negligible. Stray rejection characteristics for a-c are excellent and damping characteristics have proven effective.

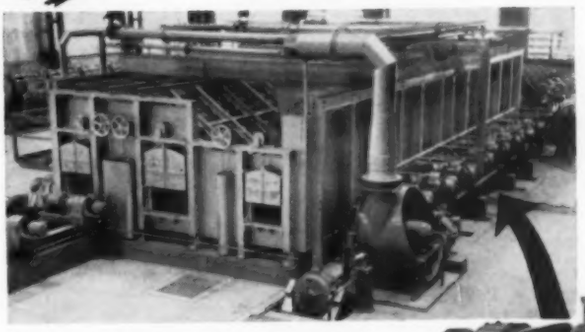
Available with pen speeds of 2, 4½, 12 and 24 seconds, the instrument may be used for small current measurement with fixed source impedance, millivoltage measurement with variable source impedance and high impedance d-c bridges.

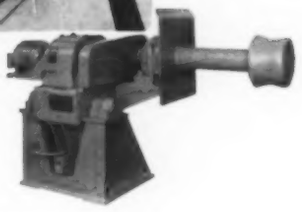
VIBRATORS

▲A new line of heavy duty, quiet action, non-impacting vibrators manufactured by the Vibron Division of Burgess-Sterbentz Corp., Cleveland, Ohio, is designed to make inert bulk materials flow freely without the jarring, nerve shattering noise produced by the impacting type vibrators.

The vibrators specifically help to reduce processing time by vibrating bins, chutes, hoppers and screens to prevent arching, clogging or sticking of materials. In addition, these vibrators eliminate air pockets and voids in form and increase carrying capacity of containers.

Enterprise FURNACE CONVEYORS ON THE JOB AT C. F. & I.





The new Flinn & Dreffein Tube Normalizing Furnace at The Colorado Fuel and Iron Corporation, Pueblo Plant, utilizes Enterprise water-cooled individually-driven roller conveyor units throughout. This furnace and its conveyor system is specially designed for normalizing 2⅜ to 9⅝ in. OD seamless tubing up to 40 ft long. Using adjustable-stroke air cylinders, these conveyors are "swung" to load and unload the furnace transfer chains . . . . For these and other specially-designed conveyor jobs, contact Enterprise today.

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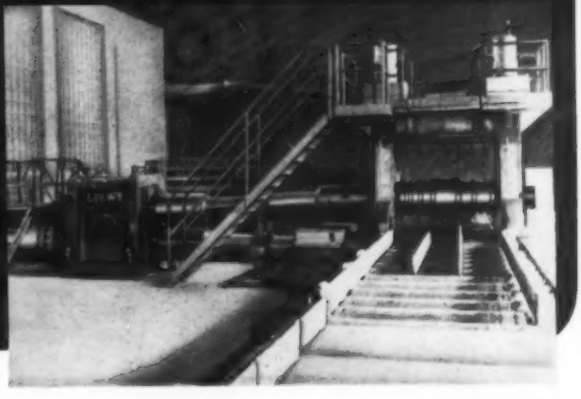
And Rolling Mill auxiliary equipment for hot and cold working of ferrous and non-ferrous metals



26" Two-High Blooming Mill, part of complete Blooming, Slabbing, Structural and Strip Mill installation.

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Rowan engineers designed and developed the original 2300-V self-supporting and self-contained motor control of the cubicle construction for indoor and outdoor service.

Standard units consist of: a self-contained, insulated bus; a self-contained control potential transformer; current-limiting or high-interrupting capacity fuses; a specially designed, quick-acting, heavy-duty contactor with non-freezing contacts; sealed-off motor lead compartment; separate low-voltage control compartment; magnetic overload relays with electric reset, instantaneous and inverse time element — and a self-contained, tank lowering device.

Additional features such as watt-hour meter, voltmeter, ammeter, potential switch, etc., can be had to meet the requirements for specific applications.

Rowan sales offices are conveniently located throughout the country. A representative is quickly available to give you complete information.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

The vibrating action is achieved by a piston which is caused to reciprocate in a cylindrical passage by introducing compressed air to the opposite ends of the cylinder. Simultaneous with the introduction of the compressed air at one end of the cylinder, the spent air at the opposite is exhausted from the cylinder. The cycle is automatic and produces as high as 5000 powerful vibrations per minute. The self-contained supercharging design increases the effective operating air pressure from 30 to 60 per cent above supply pressure resulting in a 110 per cent bonus of vibration power output. The design also prevents destructive metal-to-metal pounding, broken bolts and end plates.

The cast alloy bodies are mated with hard chromed and precision ground pistons to give long life and efficient performance. The vibrators are available in a wide range of sizes with capacities to move bulk materials up to 30 tons. They can be supplied with standard easy-to-use mounting plates or special mounts can be fabricated to meet special requirements.

PLASTIC TAPE

▲Previously available in roll, tablet (for typewriter use) or book-match form only, Labelon self-adhesive plastic "Write on it" Tape is now furnished in convenient cut-to-size strips or labels from 1 in. to 6 in. in length and from $\frac{5}{16}$ in. to 3 in. in width. Any of a variety of border colors may be specified.

In the new form, Labelon has the same advantages provided in its previous forms. It can be written on with any dry, blunt point such as a pencil or stylus. Writing appears "like magic" beneath a layer of transparent plastic due to pressure of the writing instrument alone. No ink, pencil lead or crayon is required. Writing is in the same color as the outside border.

Labelon resists temperatures from —40 to +150 F, will not curl nor discolor with age, and can be applied and reapplied an almost unlimited number of times without losing its adhesive quality.

In the new form, strips are mounted on smooth-finished special polyethylene paper, from which they peel off cleanly. This method of mounting has the additional advantage of making it easy to use the labels in a typewriter.

WELDING TOOL

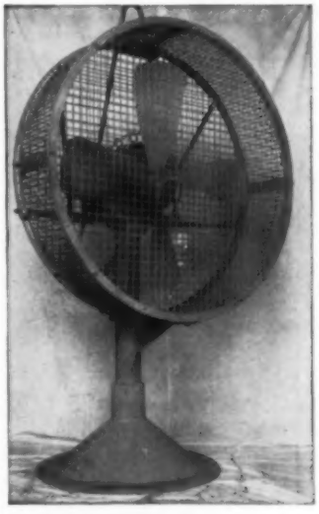
▲Utica Drop Forge & Tool Corp. has announced that the new Koldwelding tool for the lap welding of aluminum sheet or foil without heat or electricity and without flux or chemical of any kind is now ready for immediate delivery.

Tool No. KL-10 is hand operated and accomplishes the welding of aluminum foil, sheet, shaped extrusions or strip by pressing the surfaces of the parts together between specially designed dies. To prepare the metal surfaces for the weld it is merely necessary to clean them with a steel wire scratch brush (or similar mechanical action) to remove surface oxidation, dirt and grease.

IS HEAT SLOWING UP YOUR WORKMEN?

TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
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TRUFLO FAN COMPANY

245 MAIN ST: HARMONY, PA:

When De Laval Designs Your Mill Lubrication System— PIPING Is Important

When De Laval engineers design your Mill Lubrication System, they take pains with every detail, including the piping. They design all piping for "streamline flow" by combining correct size, long radius elbows and proper slope of drain lines. In other words, they make sure pressure drops and turbulent flow conditions are at a minimum, then they design the Lubrication System to fit the mill foundations and structure as a whole.

The knowledge of when and how to use a particular kind of pipe is in itself not difficult to acquire. But when the care given to the design and follow-through of a relatively simple part of a system becomes a symbol for the care given to the Mill Lubrication System as a whole, then it is important.

ALL DE LAVAL ENGINEERED MILL LUBRICATION SYSTEMS HAVE THESE SPECIFIC FEATURES:

1. Pipe Size Properly Selected
2. Lubricant Correctly Metered
3. Temperature Efficiently Controlled
4. Lubricating Oil Purified

For Large Mills:
Custom-built systems

For capacities up to 50 gpm:
The self-contained Unilube
(Available in four types)

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

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DE LAVAL SALES & SERVICE, INC.
447 Fourth Ave., Pittsburgh 19

De Laval ENGINEERED SYSTEMS

Manufacturer states that Model No. KL-10 will koldweld aluminum and electrical copper in thicknesses .001-.040, or an over-all maximum thickness of .080. Dissimilar sizes or different metals may be welded with this device. Each thickness of material requires a different size interchangeable die. The KL-10 handles all types of aluminum (except 56S and aircraft qualities in the T temper) and electrical copper.

Welds accomplished by the No. KL-10 meet the same tests as applied to conventional welds. When the weld is pulled apart fracture occurs around the periphery of the spot, pulling a slug from one of the sheets.

The tool weighs about 2¾ lb and is normally hand-operated in the manner of pliers with only average grip strength required.

ROLLER BEARING

▲A new application of single acting thrust roller bearings for use on railway transfer bridges and other high-capacity industrial loadings, has just been introduced by Rollway Bearing Co., Inc., a subsidiary of Lipe-Rollway Corp., both of Syracuse, N. Y.

One of these new bearings, type T-21906, supports a vertical thrust load of 380,000 lb at 16 rpm and has a rated capacity of 700,000 lb.

In this instance, the T-21906 roller bearing differs from most applications of single-acting thrust bearings. No center shaft is used to locate the bearing's roller assembly. Instead, a locating ring, which is roll pinned securely to the stationary plate, maintains the roller assembly in perfect alignment.

Locating ring and stationary plate make up the stationary plate assembly, which is ground on its outside diameter to be a slip fit in the housing of the machine to which it is applied.

The T-21906 bearing has additional application advantages. Besides being especially suitable for installations where space is limited, it also can be used on horizontal shaft applications to overcome the common problem of maintaining a sufficient amount of lubricant in the bore of the roller assembly. With the new

(*Please turn to page 240*)

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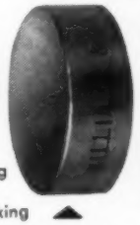
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SECTIONALIZED FLUID-ENDS

. . . afford maximum accessibility. Parts can be replaced easily and at low cost.

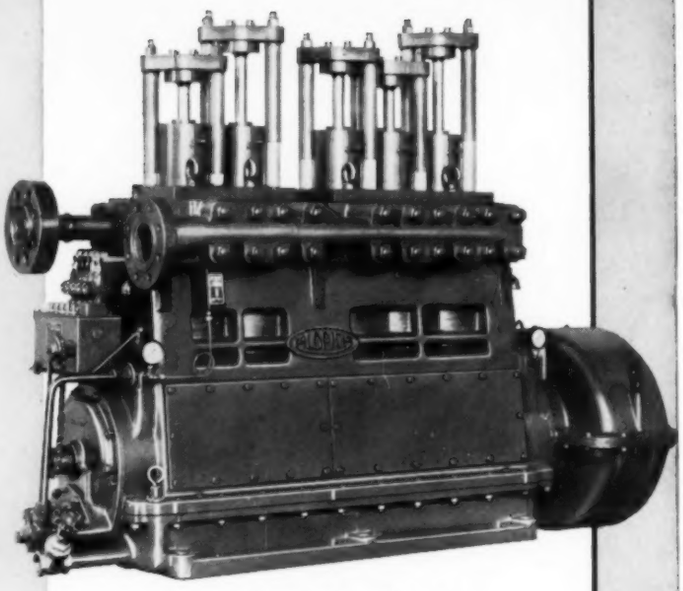
CHANGEABLE PLUNGER SIZES

In most cases plunger sizes can be changed merely by using new glands, throat bushings and packing in the same fluid-end: thus facilitating changes in pressure and volume requirements.

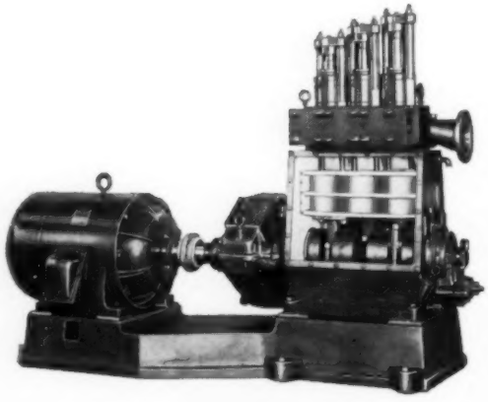
INTERCHANGEABLE WEARING PARTS

Among 3, 5, 7 and 9 plunger units all wearing parts are interchangeable. This is particularly advantageous where a combination of multiplex pumps is required, for it reduces spare parts, costs and inventories.

. . . Aldrich Direct Flow Pumps have given many years of satisfactory service to die casting manufacturers. Units are manufactured in 3″, 5″ and 6″ stroke sizes, in Triplex, Quintuplex or Septuplex models (50 to 900 hp).



Aldrich Direct Flow 5″ Stroke Quintuplex Pump. 150 hp.



Aldrich Direct Flow 5″ Stroke Triplex Pump. 100 hp.

Write us for catalogs, engineering service, or a representative's call. We invite your inquiries for pumps or complete central hydraulic systems.

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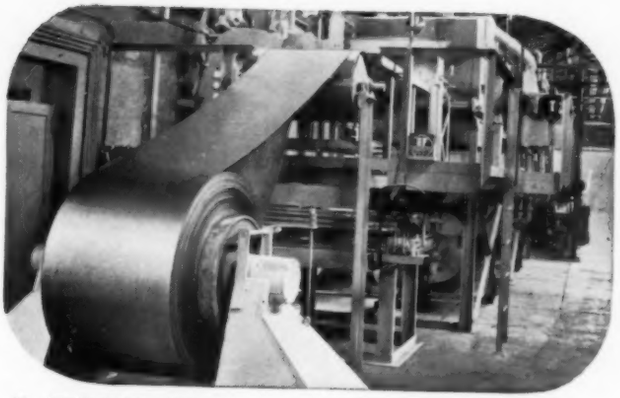

EF CONTINUOUS STRIP LINES — for annealing, galvanizing, aluminizing, etc. This combination gas-fired and electric unit provides flexibility in controllen heating, soaking and cooling, for producing various surface and metallurgical conditions on ferrous and nonferrous strip. Built by The Electric Furnace Co., Salem, Ohio.

EF CONTINUOUS FURNACES are built in many sizes and types for processing wire, sheet, castings, stampings, strip, tubing and many other products. This EF gar-fired radiant tube special atmosphere furnaces bright normalizes 3000 lbs. steel tubing per hour. Built by The Electric Furnace Co., Salem, Ohio.

EF builds Gas-Fired, Oil-Fired and Electric Furnaces for these and other heat treating operations

● EF engineers specialize in designing and building production furnaces — continuous and batch types — including roller hearth, roller rail, chain belt, wire belt, slot and tube conveyor types, reciprocating, rotary, car, bell, pit and other designs; complete with special atmosphere producers, and time and labor saving material handling equipment as required.

Reflecting more than 30 years of continuous research and experience, and outstanding engineering accomplishments, EF furnaces combine high heating efficiency, accurate automatically controlled cycles, and advanced designs that minimize maintenance, assure economy of operation, high hourly output and uniformity of product.

Submit your production furnace problems to ***experienced engineers — it pays.***

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GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS PRODUCT OR PRODUCTION
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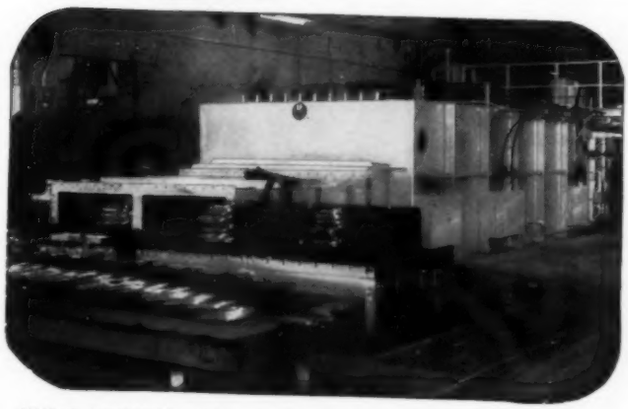
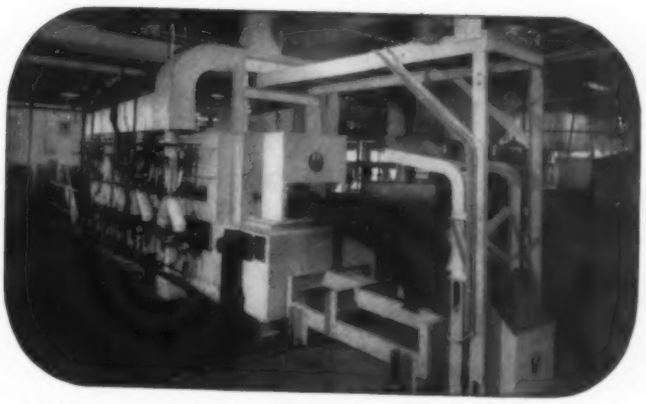


BRIGHT ANNEALING WIRE. An EF continuous bright annealing furnace in which the wire is conveyed through the various zones on two parallel rows of bulkhead type trays. This unit has convection cooling and handles 2500 net lbs. of wire per hour. Built by The Electric Furnace Co., Salem, Ohio.



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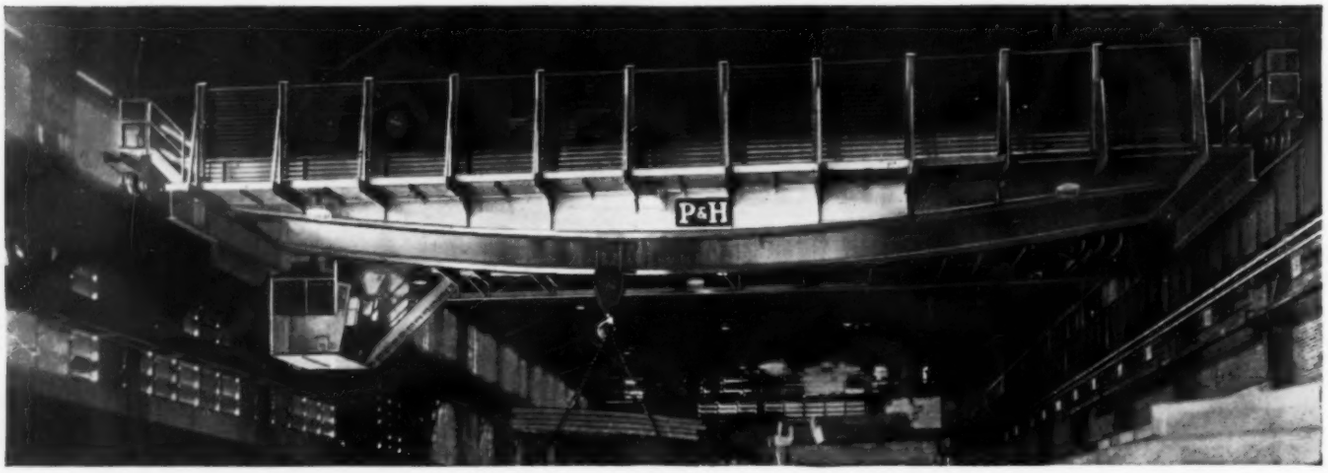

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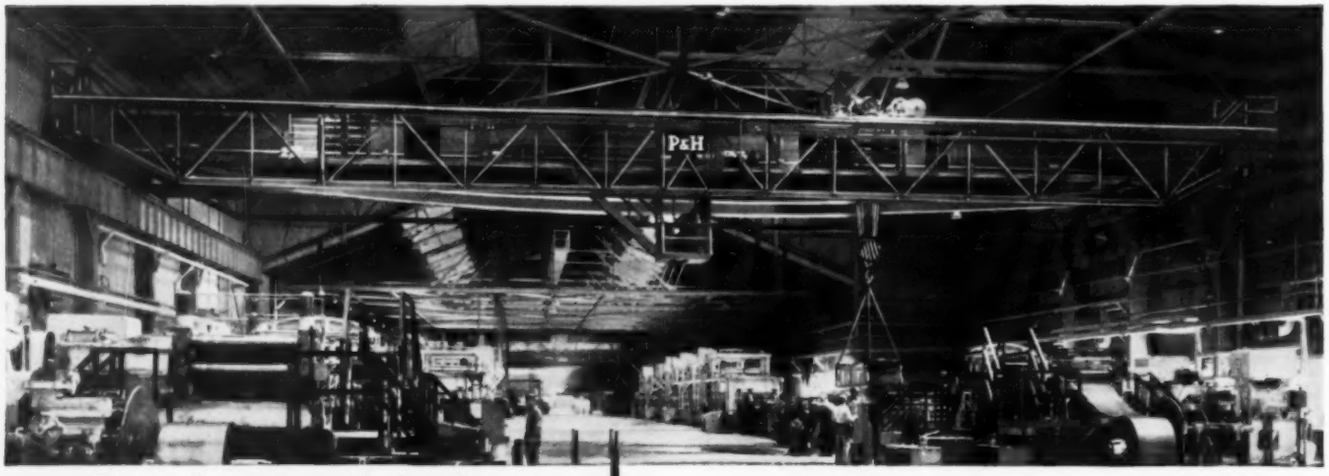

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The 1000-ton hot-metal mixer of a major steel producer recently completed a 10-month campaign, handling 1,311,750 tons of iron. The mixer lining was "balanced" with Taylor Sillimanite (TASIL) Brick, laid in TASIL Cement, in the areas of severe erosion. Not a single brick was replaced nor any patching attempted during the campaign.

This sets a new mixer record, both for tonnage handled and continuous operation . . . and is the 9th *consecutive year* that TASIL "balanced" linings have been in service at this plant!

Let a Taylor field engineer give you full details on this proven TASIL application for mixers, ladles and hot-metal cars.

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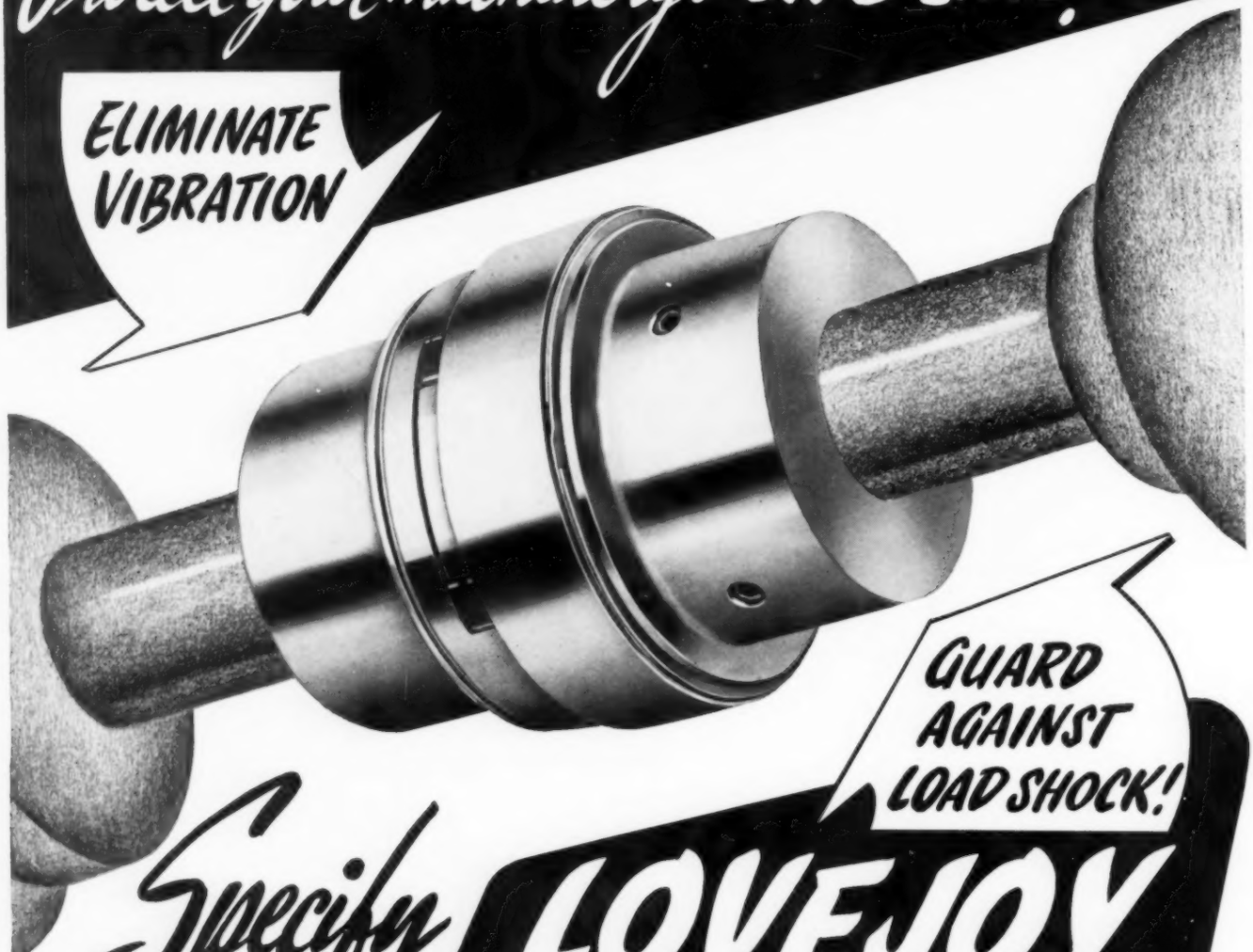

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Manufacturers of Couplings, Universal Joints and Variable Speed Transmissions

Pickling tank and wash tank at Laclede Steel Company. Note the rolls fabricated from tough corrosion- and wear-resistant Ampco Metal. Roll dimensions 31″ OD x 29″ ID x 36″ long. Side plates 34½″ OD x ½″ thick with 5″ ID for shaft.

Here's another roll used at Laclede. Fabricated from money-saving Ampco Metal, it handles six strips at a time.

Laclede Steel
fights wear and corrosion in its pickling line with
AMPCO METAL*

. . . keeps production up . . . costs down

Steel companies throughout the country are faced with terrific production problems. Laclede Steel Company, St. Louis, like so many others, found one answer in Ampco Metal.

Shown here is their pickling operation. The tank carries a 12% sulphuric acid solution at 200°F. The strip enters the tank and goes through the entire process via wear- and corrosion-resistant Ampco Metal rollers.

The rollers and side plates are fabricated from Ampco Grade 8 plate. Shafts and nuts are made from extruded Ampco Grade 15.

But resistance to corrosion in pickling service isn't the only important feature of Ampco Metal. It also resists wear, shock, impact. That's why so many mills use Ampco Metal screw-down nuts, slippers, wear plates, flash-welder dies.

If you have a corrosion problem or a wear problem, it pays to investigate the advantages of Ampco Metal. See your nearby Ampco field engineer or write us for details.

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AMPCO®

8-11

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If your company is one of the more than 45,000 companies that have the Payroll Savings Plan you *know* what your employees think of Savings Bonds—they spell it out for you every month in their Savings Bond allotments.

If you don't have the Payroll Savings Plan, and are wondering whether your people would like to receive their bonus in Bonds, here are a few significant facts:

—every month, *before they get their pay checks or envelopes*—8,000,000 men and women enrolled in the Payroll Savings Plan invest $160,000,000 in U. S. Savings Bonds.

—the ranks of Payroll Savers are growing: On June 30th sales of $25 and $50 Savings Bonds, the sizes purchased chiefly by Payroll Savers, were 6% and 9% higher than in the corresponding period of 1952.

—Payroll Savers hold their Bonds: 75% of the $7,400,000,000 Series E Bonds which had matured up to June 30, 1953, were being retained by their owners beyond maturity under the automatic extension program.

—on June 30, 1953, the *cash value* of Series E and H Bonds—the kind sold only to individuals—totaled $36,048,000,000, a new high.

It costs no more to give your Christmas Bonus in Savings Bonds. To the Payroll Saver, and to the man who buys his Bonds at a bank (because his company does not provide the Payroll Savings Plan) a One Hundred Dollar Savings Bond looks bigger and better than a check for $75. *Make this a merrier Christmas for every employee. Give the gift that keeps on giving.*

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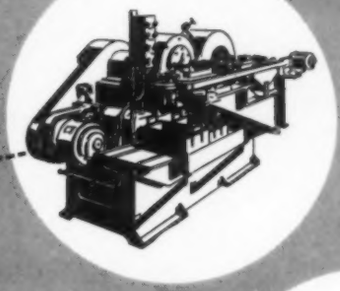

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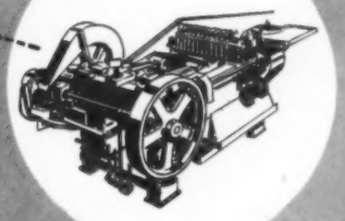

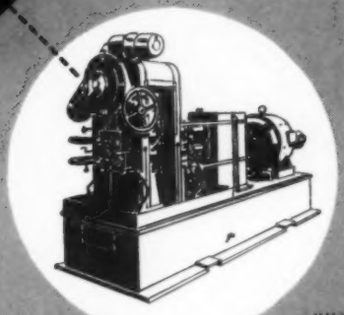

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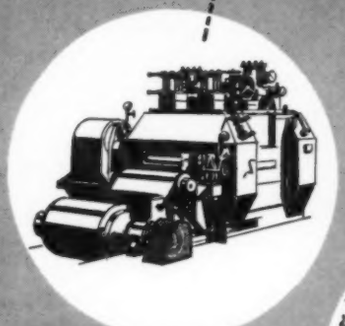

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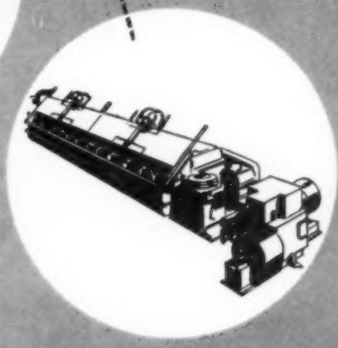

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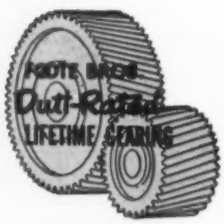

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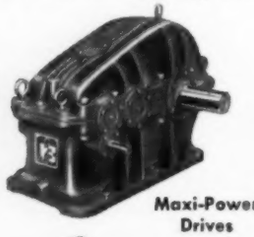

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Illustration courtesy of Niagara Machine & Tool Works.

CLEVELAND worm gearing drives Niagara bending roll

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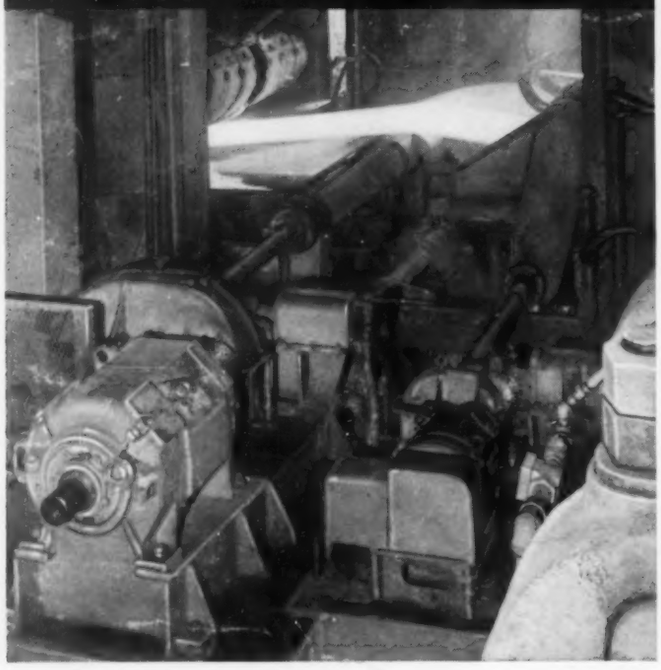

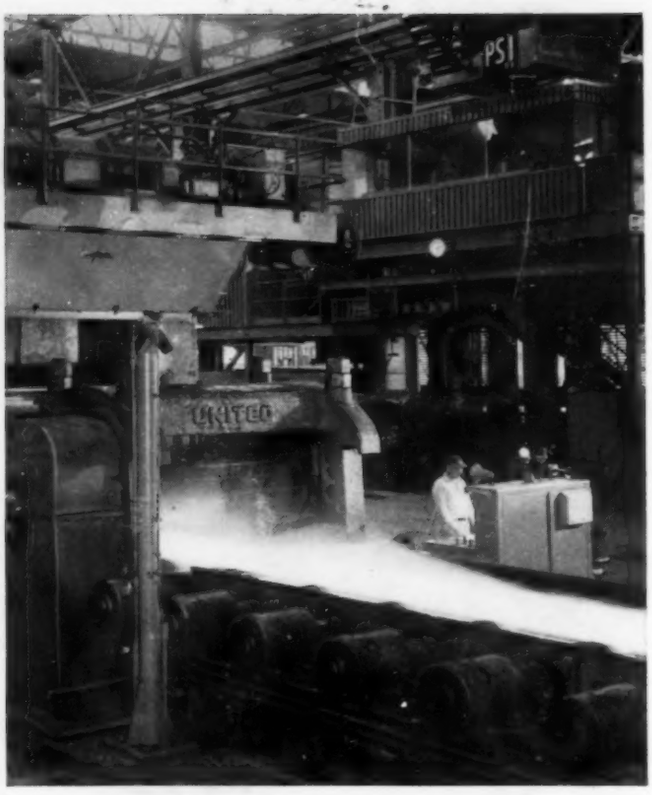

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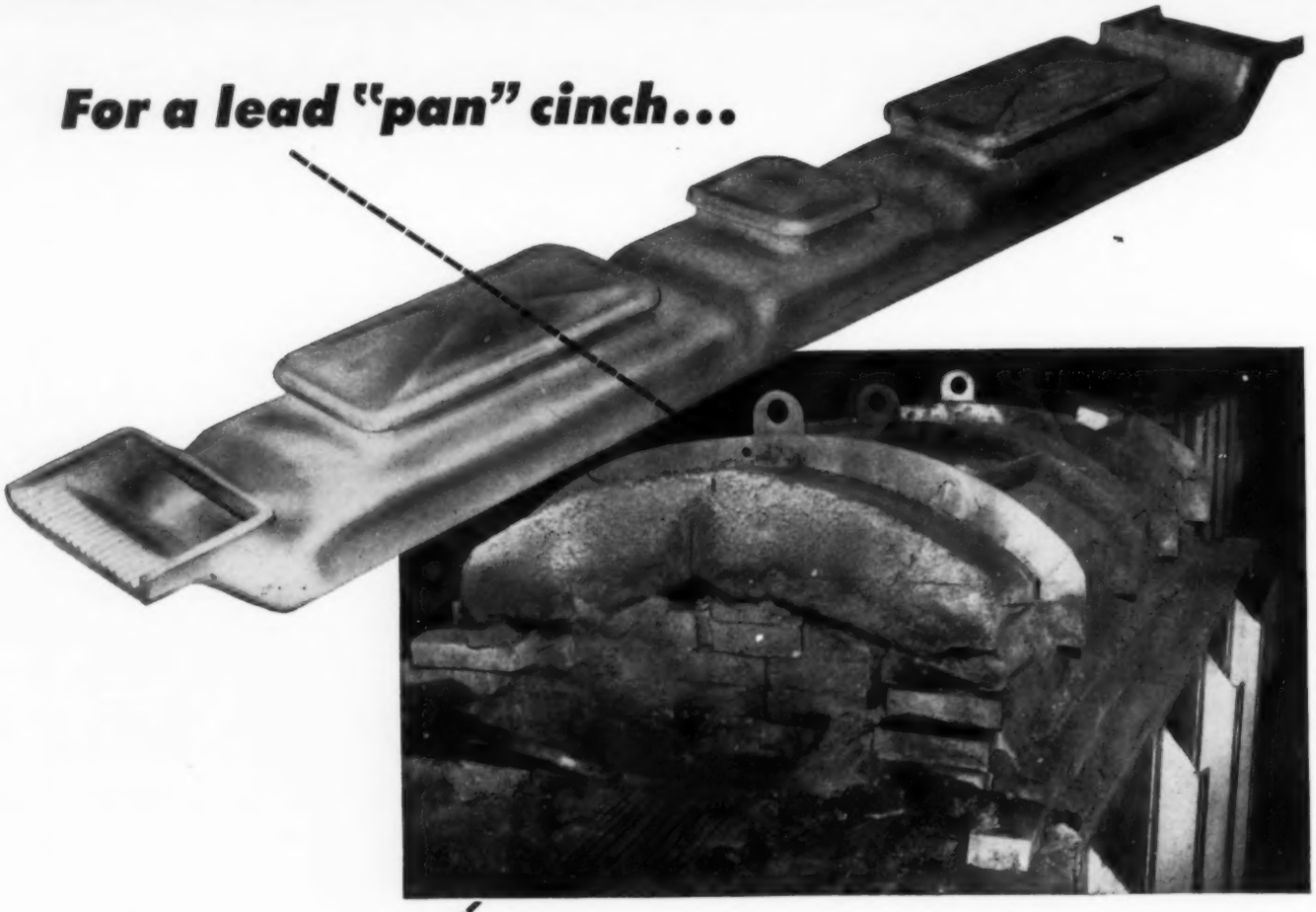

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EQUIPMENT NEWS

(*Continued from page 221*)

thrust bearing, oil reaches and remains between the locating ring and the roller assembly, a condition not always evident in standard thrust bearings.

Type T-21906 roller bearing is 25¾ in. outside diameter, 17 in. inside diameter and 3¾ in. thick.

FAN COOLED MOTOR

▲ A new motor built by Reuland Electric Co. incorporates a high-velocity internal cooling fan. Because of its greater cooling capacity, much higher horsepower ratings can be obtained from lower cost, small frame sizes.

As an example of this new design, a 30-hp motor, which ordinarily requires a No. 365 frame, is built into a No. 326 frame. The fan (13-in. diam x 5⅞-in. wide) is mounted on the motor's shaft and is housed within the special fin-type endbell. Air is sucked in through a screen filter opening and blown with great force over all internal areas.

Greater compactness, as well as price reductions of as much as 15 per cent, are achieved through this new design.

Reuland High-Velocity Fan Cooled Motors are available in ratings from 15-hp through 30-hp. All units feature a drip proof construction and can be furnished with either a standard single-end shaft or special hydraulic pump mount endbells.

COUPLING

▲ Stemlock, a re-usable coupling for connecting hydraulic hose and tubing, has been developed for the fluid power field by Maeward Couplings, Inc., which is represented by the Powertube Engineering Co. of Olivet, Mich. A revolutionary type of coupling, it provides a simple, inexpensive method of connecting hydraulic tubing to pressure hose from ¼-in. I.D. to 2-in. I.D.

The Stemlock coupling assures increased economy because it permits maximum use of low cost tubing and eliminates the need for special "adaptor" couplings. Inasmuch as Stemlock allows 360 degree rotation of tube after assembly, easy positioning is assured and very close tolerances are unnecessary. Fast, easy assembly and ninety degree tube bends within ½-in. of coupling nipple are other outstanding features of the new coupling.

Completely tested and proven, the Stemlock coupling is guaranteed to withstand burst pressure of hose without danger of bead collapse or blowout. An "O" ring seal prevents static or impulse pressure leaks.

Book Reviews . . .

"Productivity in the Light Flat-Rolled Segment of the Steel Industry," by Thomas F. Walsh, S. J. is an interesting publication issued by Fordham University in New York. This book is the third in a series of publications printed in connection with the Industrial Economics Program at Fordham University carried out under the direction of William T. Hogan, S. J. The report is a statistical study which gives data on man-hours, output and productivity including trends on hot strip and various types of cold reduction mills. Similar data is given for hot dipped and electrolytic tin facilities. Studies are based on actual plants whose identities are not given in the report. Plants, however, are modern units and apparently representative of the industry. The book should be of particular interest to mill operators who would like to compare their unit costs with the ones described in the booklet. 6 x 9 in. — Paper bound — 64 pages.

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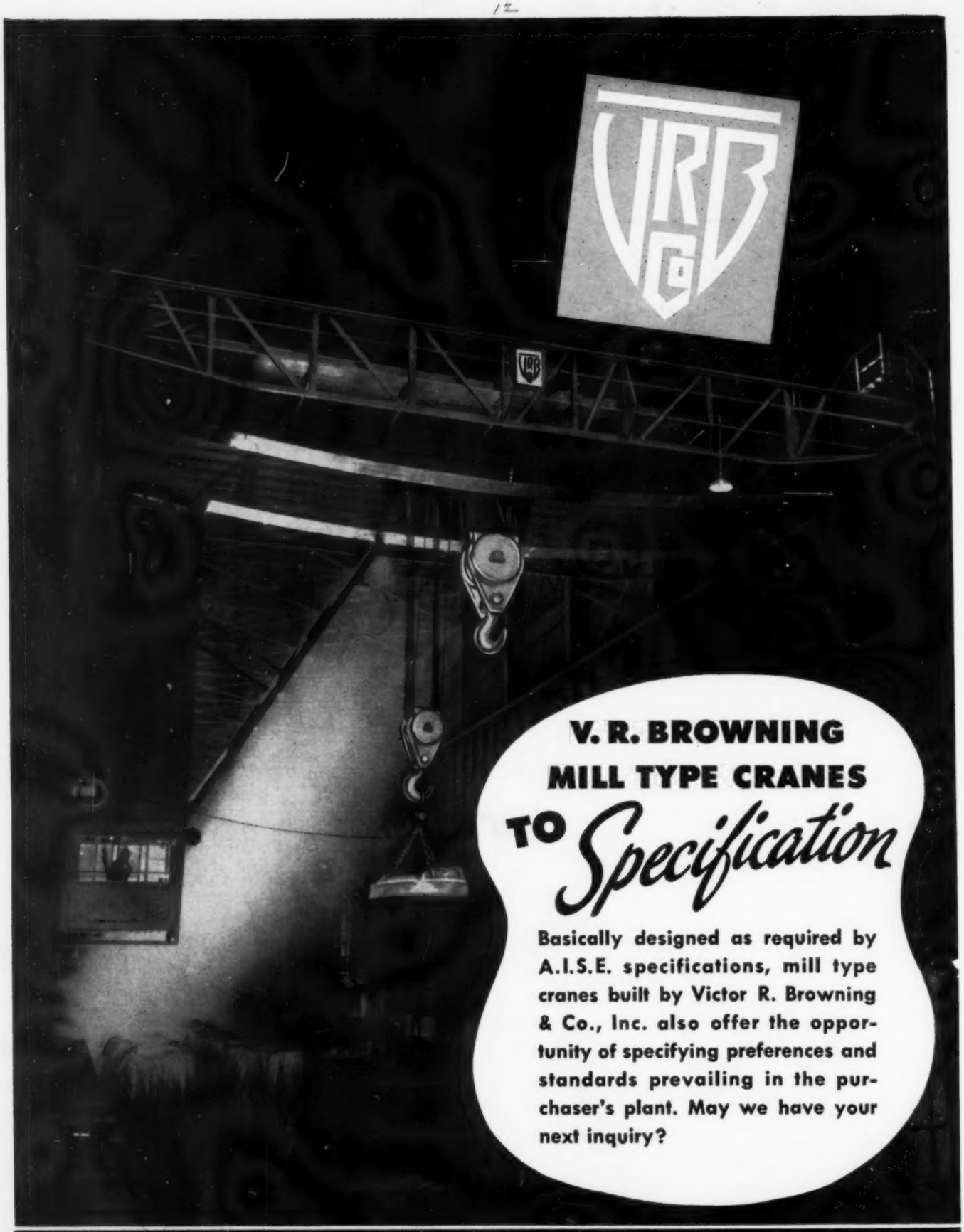
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